

GENERIC QUALITY ASSURANCE PLAN

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For

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1.0 Introduction

This is a generic quality assurance plan for all sampling and analytical programs of the South Florida Water Management District. These programs encompass ground, surface, and estuarine water monitoring programs. The chemistry laboratory is certified by the Florida Department of Health and Rehabilitative Services as an environmental laboratory, capable of performing the metals, nutrients and general parameter I & II categories..

The following quality assurance plan describes the policies, organization, objectives, functional activities, and specific QA/QC procedures used by the sampling and analytical programs at the South Florida Water Management District.

2.0 Statement of Policy

The policy of the South Florida Water Management District can best be expressed through the Mission Statements which have been developed for the District, the Department of Research and Evaluation, Water Quality Division, and the Chemistry Laboratory Division.

The Mission of the South Florida Water Management District is to manage water and related resources for the benefit of the public and in keeping with the needs of the region. The key elements of the Mission are: environmental protection and enhancement, water supply, flood protection, and water quality protection. The Mission is accomplished through the combined efforts of planning and research, operations and maintenance, community and government relations, land management, regulation and construction. Inherent in the Mission is the responsibility to assist the Public and Government Officials by protecting water resources and by identifying and recommending options for incorporating water resource considerations into land use decisions.

The Mission of the Department of Research and Evaluation is to plan for the balanced, multi-purpose management of water and related resources in support of the District Mission Statement by:

CONDUCTING accurate, comprehensive, applied scientific research, assessments, and evaluation.

PROVIDING advice, guidance, and support to the operational, regulatory, and executive units of the District, and federal, state and local governments.

DEVELOPING sound workable plans and strategies to address both short and long term water management, related resource management, and growth management problems.

The Mission of the Water Quality Division is to provide the data base, technical capability, and interpretive insight necessary to address the water quality aspects of water management issues affecting the District. The objectives of the Water Quality Division are:

1. To conduct and scientifically document monitoring and research programs designed to maintain baseline records, develop water quality criteria, evaluate management alternatives, and investigate non-point pollution sources and controls.
2. To provide technical evaluation of water quality issues impacting the regulatory, operational, and administrative functions of the District.
3. To inform and advise on water quality aspects of the District's resource management policies.

The Mission of the Chemistry Laboratory Division is to provide analytical services and maintain a laboratory data base to support District programs. This is accomplished through the following:

1. Use of accepted methods of analysis with up to date instrumentation and computer resources for data acquisition and storage from the instruments.
2. A quality assurance program which guarantees the accuracy of all analyses performed by the laboratory.

Inherent in the Mission Statement is the commitment to endeavor to increase services to meet the needs of District programs by training of personnel, acquisition of new equipment and the addition of new parameters.

3.0 Organization

The following four figures illustrate the organizational structure of the South Florida Water Management District (figure 3-1), the Department of Research & Evaluation (figure 3-2), the Chemistry Laboratory Division (figure 3-3), and the Water Quality Division (figure 3-4). The Chemistry Laboratory and Water Quality Divisions are a part of the Department of Research & Evaluation. The Chemistry Laboratory Division is responsible for analyzing the samples collected by the Water Quality Division.

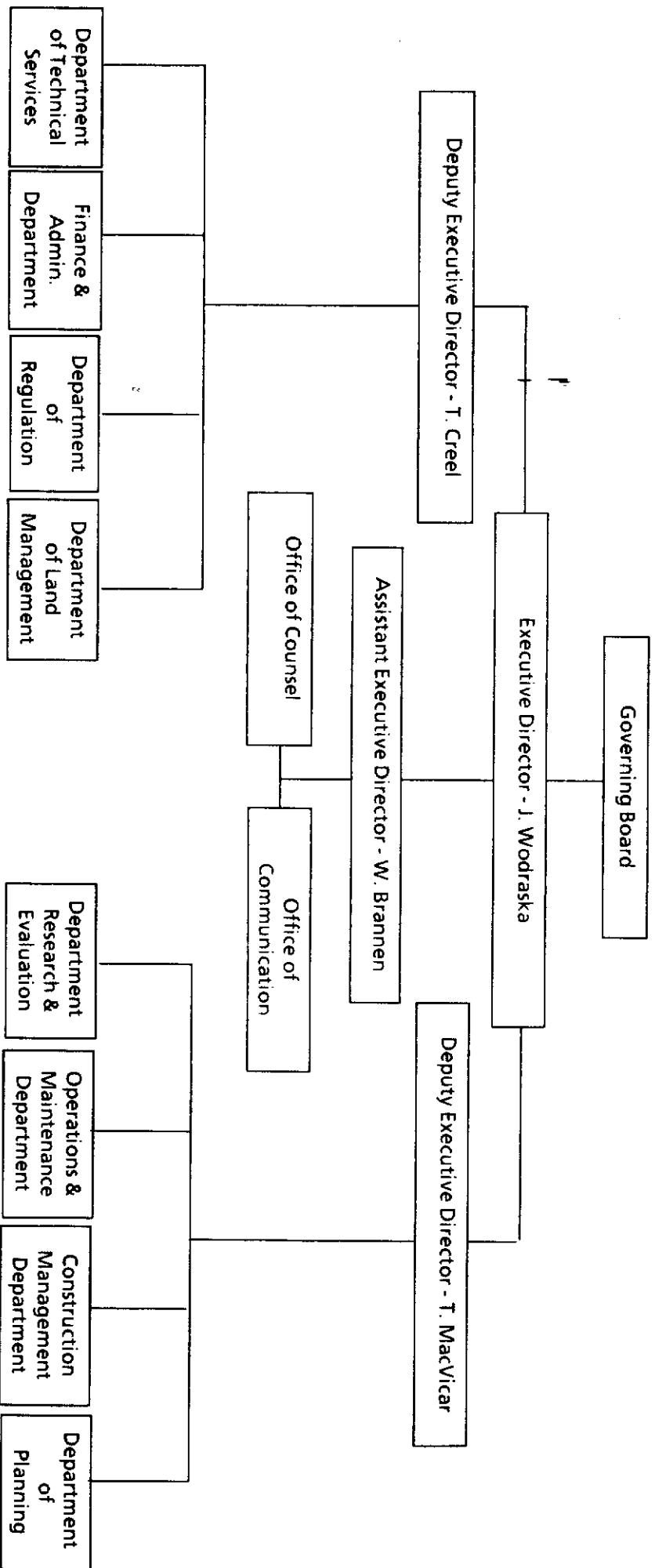


Figure 3-1 SFWMD Organization

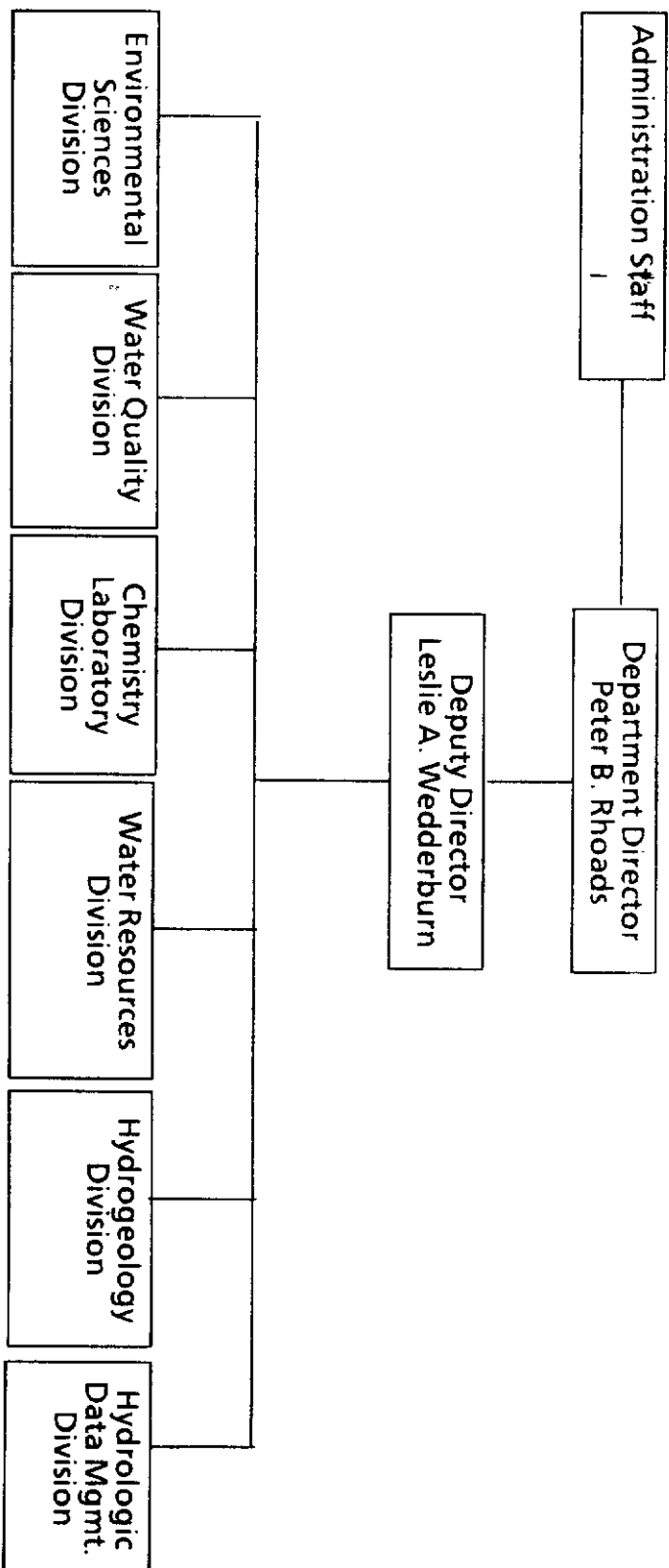


Figure 3-2 DRE Organization

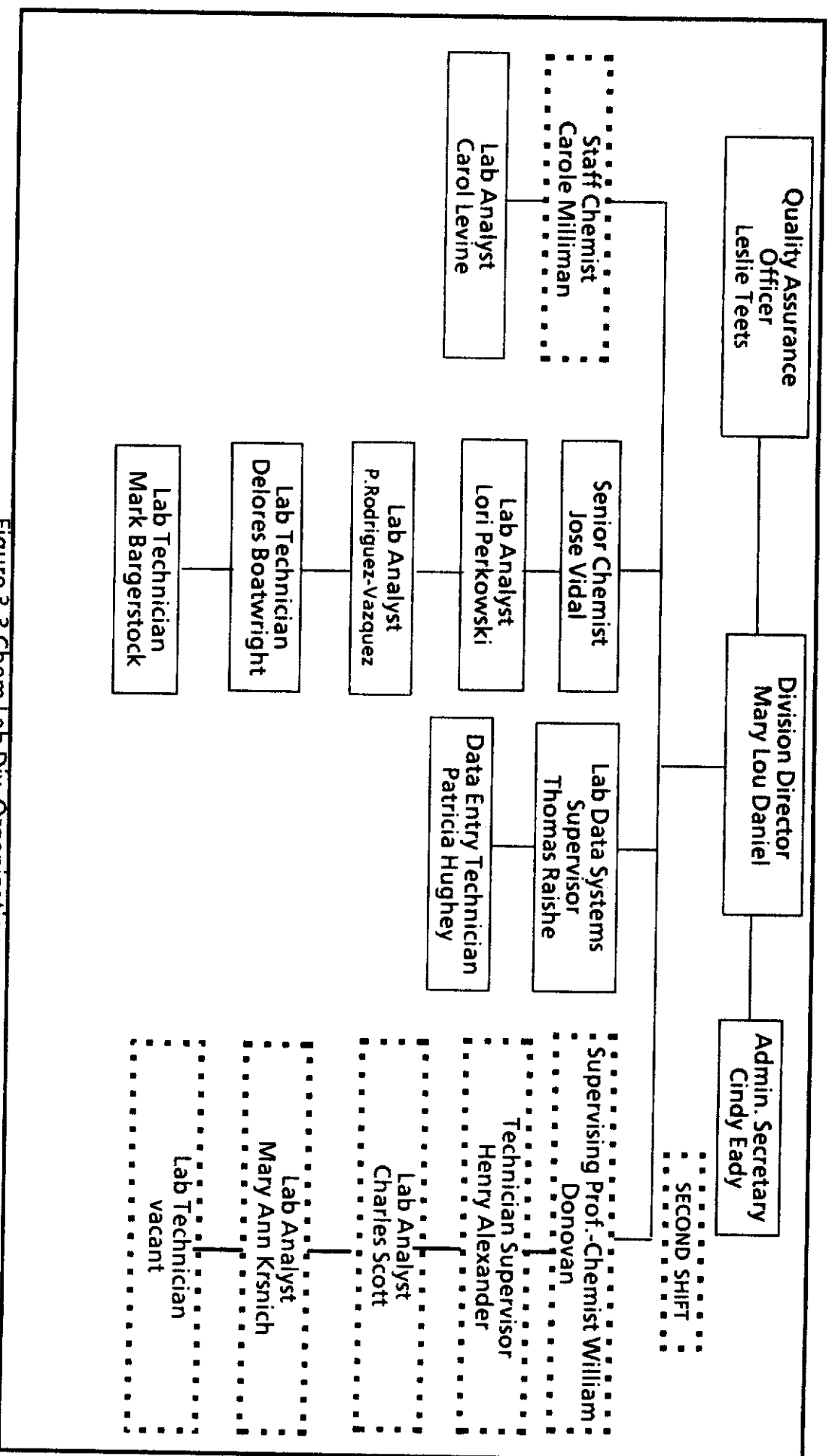


Figure 3-3 Chem Lab Div. Organization

Chemistry Laboratory Division Responsibilities:

Mary Lou Daniel, Division Director - Management of the division, technical problem solving, budgeting, scheduling.

Cindy Eady, Administrative Secretary - Administrative support to the Chemistry Laboratory Division.

Thomas A. Raishe, Lab Data Systems Supervisor - Operation and management of the division laboratory information management system.

Leslie W. Teets, Lab Quality Assurance Officer - Responsible for supervision of atomic absorption spectroscopy, and the laboratory quality assurance program, preparation of field QC spiking solutions.

Jose L. Vidal, Senior Chemist - Responsible for nutrients, and physical parameters and supervision of first shift technicians.

William C. Donovan, Supervising Professional-Chemist - Responsible for the second shift supervision of the chemistry laboratory personnel and data quality.

Henry Alexander, Technician Supervisor - Responsible for supervision of the second shift laboratory technicians and anion determinations.

Patricia Hughey, Data Entry Technician - Responsible for data entry and running of routine computer programs.

Pedro Rodriguez-Vazquez, Laboratory Analyst - Responsible for nutrient digestions and physical parameters.

Lori Perkowski, Laboratory Analyst - Responsible for nutrient analysis and wet chemical procedures using continuous flow analyzers.

Charles C. Scott, Laboratory Analyst - Responsible for the digestion and analysis of all total phosphates.

Carol Levine, Laboratory Analyst - Responsible for flame atomic absorption analyses, and trace metal sample preparation.

Delores Boatwright, Laboratory Technician - Responsible for physical parameters, TKN digestion and labware cleaning.

Mary Ann Krsnich, Laboratory Analyst - Responsible for TKN and TDKN analyses, cleaning of lab and plastic ware.

Carole Milliman, Staff Chemist - Responsible for trace metal analyses by furnace atomic absorption spectrophotometry.

Mark Bargerstock, Laboratory Technician - Responsible for total Kjeldahl nitrogen digestion, physical parameters and labware cleaning.

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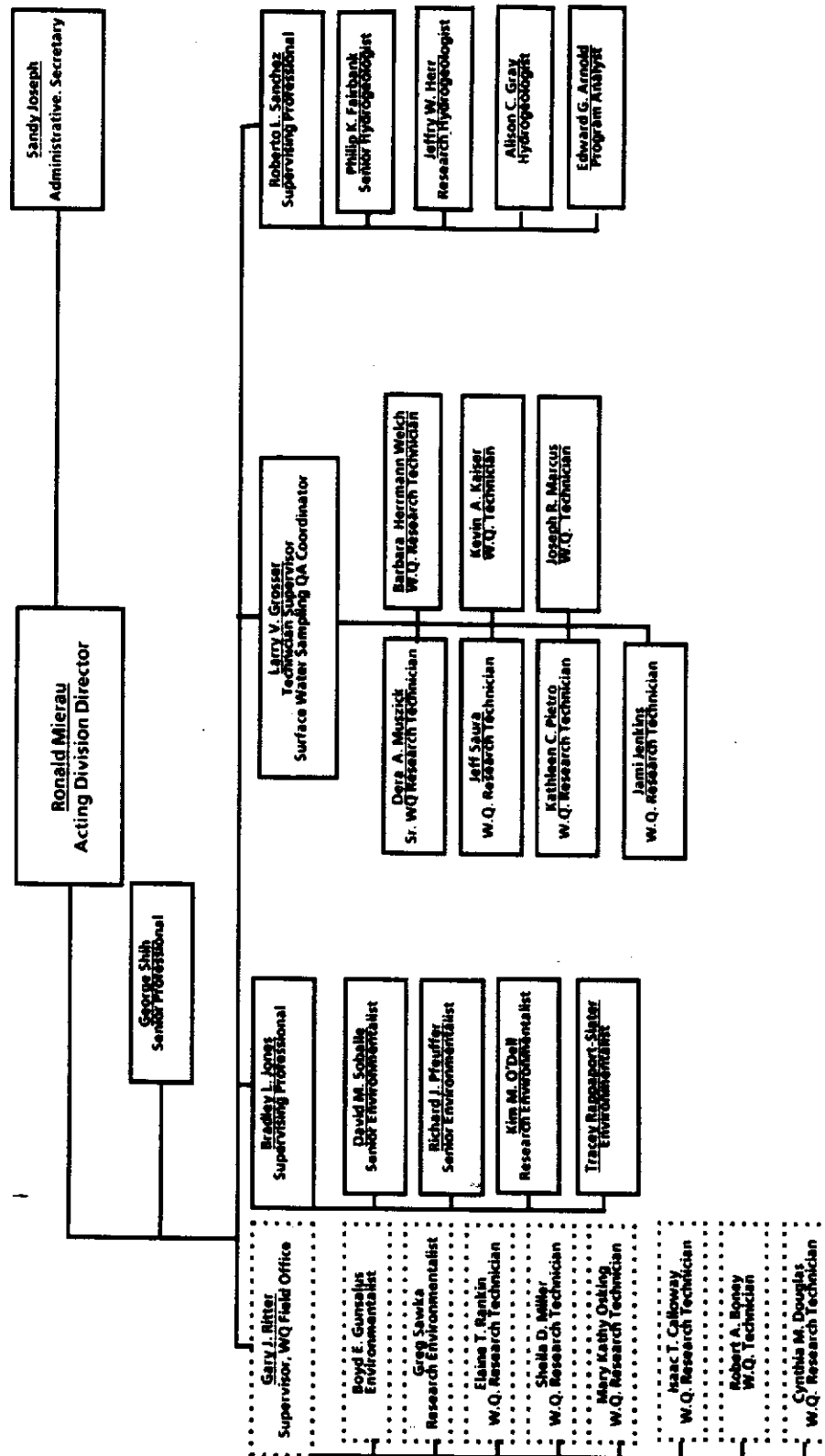


Fig. 3-4

4.0 Quality Assurance Objectives Table

Laboratory Measurement Parameters

MEASUREMENT PARAMETER (Method)	REFERENCE*	EXPERIMENTAL MATRIX	PRECISION (%RSD, sd)	ACCURACY (%R, sd)	COMPLETENESS (%)
Alkalinity	EPA 310.2	Surface H ₂ O Ground H ₂ O	1.8, 1.2	95.5, 6.7	94
Aluminum (Total & Dissolved)	EPA 202.2	Surface H ₂ O Ground H ₂ O	1.8, 0.2	104.5, 6.1	84
Ammonia	SM 417G	Surface H ₂ O Ground H ₂ O	3.4, 2.5	101.7, 6.2	91
Arsenic (Total)	EPA 206.5 + EPA 206.2	Surface H ₂ O Ground H ₂ O	5.0, 2.2	98.9, 7.9	92
Arsenic (Dissolved)	EPA 206.2	Ground H ₂ O	5.0, 2.2	98.9, 7.9	98
Cadmium (Total & Dissolved)	EPA 213.2	Surface H ₂ O Ground H ₂ O	9.7, 7.8	83.4, 14.8	84
Calcium (Dissolved)	SM311A	Surface H ₂ O Ground H ₂ O	2.4, 2.2	100.6, 2.3	94
Chloride	SM 407D	Surface H ₂ O Ground H ₂ O	2.4, 2.6	99.1, 6.2	93
Chromium (Total & Dissolved)	EPA 218.2	Surface H ₂ O Ground H ₂ O	4.8, 4.8	99.9, 14.2	92
Cobalt (total & Dissolved)	EPA 219.2	Surface H ₂ O Ground H ₂ O	5.5, 0.6	99.0, 3.2	95
Color	SM 204A modified**	Surface H ₂ O Ground H ₂ O	2.2, 1.9		98
Copper (Total & Dissolved)	EPA 220.2	Surface H ₂ O Ground H ₂ O	5.2, 2.7	92.4, 20.3	89

MEASUREMENT PARAMETER (Method)	REFERENCE*	EXPERIMENTAL MATRIX	PRECISION (%RSD, sd)	ACCURACY (%R, sd)	COMPLETENESS (%)
Fluoride	SM 413 C	Ground H ₂ O	8.0, 5.6	102.3, 20.1	89
Hardness	SM 314B	Surface H ₂ O Ground H ₂ O			94
pH	SM 423	Surface H ₂ O Ground H ₂ O	2.5, 2.0		96
Iron (Total & Dissolved)	SM 315B	Surface H ₂ O Ground H ₂ O	3.3, 2.6	101.8, 7.6	90
Kjeldahl Nitrogen (Total)	EPA 351.1	Surface H ₂ O Ground H ₂ O	3.1, 2.2	95.8, 9.9	94
Lead (Total & Dissolved)	EPA 239.2	Surface H ₂ O Ground H ₂ O	4.6, 4.0	92.1, 16.0	90
Magnesium (Dissolved)	SM 303 A	Surface H ₂ O Ground H ₂ O	4.6, 4.0	92.1, 16.0	98
Manganese (Total & Dissolved)	EPA 243.2	Surface H ₂ O Ground H ₂ O	2.2, 2.8	100.3, 10.6	96
Mercury (Total & Dissolved)	EPA 245.1	Surface H ₂ O Ground H ₂ O	5.1, 2.9	107.1, 8.9	95
Nickel (Total & Dissolved)	EPA 249.2	Surface H ₂ O Ground H ₂ O	6.9, 4.1	93.9, 14.7	85
Nitrate	EPA 352.1	Surface H ₂ O Ground H ₂ O	6.9, 4.1	93.9, 14.7	93
Nitrate- Nitrite	SM 418F	Surface H ₂ O Ground H ₂ O	8.0, 4.7	102.9, 5.9	96

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MEASUREMENT PARAMETER (Method)	REFERENCE*	EXPERIMENTAL MATRIX	PRECISION (%RSD, sd)	ACCURACY (%R, sd)	COMPLETENESS (%)
Nitrite	SM 419	Surface H2O Ground H2O	7.9, 4.0	102.5, 4.0	93
Ortho-Phosphate	SM 424G	Surface H2O Ground H2O	3.4, 3.6	98.7, 9.1	95
Phosphorus, Total	SM 424G	Surface H2O Ground H2O	3.0, 4.3	89.2, 11.0	90
Potassium (Dissolved)	SM 303A	Surface H2O Ground H2O	3.0, 1.7	102.9, 4.3	91
Residue, Filterable	SM 209B	Surface H2O Ground H2O	9.0, 37.2		86
Residue, Nonfilterable	EPA 160.2	Surface H2O Ground H2O	10.5, 3.3		94
Residue, Volatile	EPA 160.4	Surface H2O Ground H2O	17.4, 19.9		92
Selenium (Total & Dissolved)	EPA 270.2	Surface H2O Ground H2O	3.9, 0.6	106.3, 23.0	89
Silica (Dissolved)	SM 425C	Surface H2O Ground H2O	5.1, 2.9	102.0, 5.9	92
Silver (Total & Dissolved)	EPA 272.2	Surface H2O Ground H2O	10.0, 0.3	94.7, 7.7	93
Sodium (Dissolved)	SM 303A	Surface H2O Ground H2O	3.3, 2.4	100.3, 3.1	94
Specific Conductance	SM 205	Surface H2O Ground H2O	1.2, 2.2		94
Strontium (Dissolved)	SM 303A	Ground H2O	2.5, 0.04	97.0, 7.2	96
Sulfate ***	EPA 300.0	Surface H2O Ground H2O	6.6, 3.9	100.3, 9.4	87
Turbidity	SM 214A	Surface H2O Ground H2O	3.8, 2.5		98
Zinc (Total & Dissolved)	EPA 289.1	Surface H2O Ground H2O	2.3, 1.6	103.2, 8.8	95

Field Measurement Parameters

MEASUREMENT PARAMETER (Methods)	REFERENCE*	EXPERIMENTAL MATRIX	PRECISION (%RSD, sd)	ACCURACY (%R, sd)	COMPLETENESS (%)
Temperature	EPA 170.1	Surface H2O Ground H2O			
Oxygen (Dissolved)	EPA 360.1	Surface H2O			
pH	EPA 150.1	Surface H2O Ground H2O			
Specific Conductance	EPA 120.1	Surface H2O Ground H2O			
Chlorophyll	SM1002G	Surface H2O			

*Approved Methods, See 40 CFR Ch. 1, Part 136, (7-1-89 Edition)

**See Appendix A.

*** See Appendix B.

Additional References:

Taylor, John Keenan, "Quality Assurance of Chemical Measurements", Lewis Publishers: Chelsea, Michigan, 1987.

Garfield, Frederick M.; Kirchner, Cliff J.; "Quality Assurance for Analytical Laboratories, Short Course", The 102nd Association of Analytical Chemists Annual International Meeting and Exposition; Palm Beach, FL; August 27, 28, 1988.

5.0 Sampling Procedures

Sampling procedures are split into two categories, surface water and groundwater, which are discussed separately.

5.1 Laboratory Cleaning Procedures

Sampling begins with the preparation of the bottles and filter holders by the laboratory staff. The reusable polyethylene bottles, filter holders, and bottle caps are detergent washed with Liquinox™, tap water rinsed, acid rinsed with 10% hydrochloric acid, alkali rinsed with pH>12 sodium hydroxide, tap water rinsed three times, deionized water rinsed three times, and air dried. [The sinks, drains, and pipes in the labware washing room are galvanized; the alkali rinse is used to neutralize traces of the acid rinse to prevent corrosion of the galvanized fixtures.] Dry bottles are stored with the caps on and the filter holders are stored in covered containers to prevent contamination.

Polyethylene trace metal bottles are soaked in 20% nitric acid, tap water rinsed, deionized water rinsed and stored with deionized water acidified to 1% HNO₃. In the field, the soaking solution is discarded prior to sampling, the bottle is rinsed with a small portion of sample which is discarded, and then the bottle is filled with sample for analysis.

The filter holders are soaked in a weak sodium hypochlorite solution following their use in the field. This is done to protect the laboratory staff from any bacteria which may be in the filter holders from the sampling process. The filter holders are then cleaned using the procedure described in the first paragraph of this section.

Prior to leaving the laboratory on the day of the sampling trip, the sampling personnel load the filter holders with the appropriate prefilter and filter. Deionized water is processed through each filter to check for leaks and seal the filter membranes. The loaded filter holders are kept in clean sealed plastic bags to maintain a moist environment to prevent the membranes from becoming dry.

Glass bottles for the collection of organic samples are provided by the contract laboratory which will be performing the analysis. They have been cleaned by the contract laboratory according to that laboratory's procedures prior to shipment to the District.

A commercial labware washer is used to clean the majority of the labware and glassware used in the laboratory. Polyethylene sample bottles, TFE sample bottles, and 47mm filter holders used by sample collection personnel are cleaned in the laboratory using the following procedures.

Certain types of labware require preliminary cleaning measures before following the general cleaning procedures. Prior to washing, sample bottles are inspected for any sample residue. Residue is most often found in larger polyethylene bottles used to store unfiltered samples. A hot soap solution made with Liquinox™ and bottle brushes are used to scrub the bottle interior to remove all visible signs of residue.

The washer is equipped with various types racks designed to accommodate different kinds of labware. Sample bottles of similar size are placed upside down in open racks; test tubes are placed upside down on spindle racks; bottle caps and filter holders are placed in single layers in open racks and secured with stainless steel open mesh covers and clips. Beakers are placed either in open racks or spindle racks depending on size. Once a rack is loaded the labware washer cleaning program is PREWASH for 2 minutes, WASH for 4 minutes, and first tap water RINSE for 4 minutes. The loaded rack is then taken from the dishwasher and completely immersed in a 10% HCL bath, allowed to drain briefly, and immersed in a NaOH, $\text{pH} > 12$ bath (the purpose of the NaOH rinse was explained in Section 5-1). The loaded rack is returned to the labware washer for the final portion of the cleaning program which is a series of rinses: the second and third tap water RINSES for 4 minutes each and three DI water RINSES lasting a total of thirty seconds. The contents of the rack are inspected to ensure they are adequately rinsed. If NaOH remains as indicated by a slick residue, all 4 rinse cycles are repeated.

Cleaned labware is removed from labware washer racks, placed on drying racks, and allowed to air dry. When dry, each item is visually inspected as it is removed from drying racks. Sample bottles and filter holders are capped with their respective lids before being placed in the designated storage bins.

If there are only a few pieces of labware to be cleaned or the items are very large, such as one and two liter flasks or beakers, washing by hand is more practical. Items are washed by hand using a soap solution made with Liquinox™ and various sized bottle brushes or sponges, thoroughly rinsed with tap water, and dipped into the acid and alkali baths previously described. The labware is rinsed with tap water and then RO water and dried and stored in the same manner as machine washed labware.

Volumetric flasks are dedicated for each parameter. On a daily basis, the flasks are rinsed three times with deionized water, air dried, and inspected to ensure they are dry before their next use. The flasks are cleaned according to the manual washing procedure on a monthly basis at minimum. Each analyst is responsible for cleaning his own labware.

The 10% HCL acid bath and alkali $\text{pH} > 12$ bath are dumped and prepared fresh each month or more often if necessary. The pH of the alkali bath is checked each week. Used pipettes are soaked in Liquinox™ soap solution until cleaning. Pipette cleaning takes place in a pipette washer. Three volumes of tap water are used for washing and preliminary rinsing. Three volumes of deionized water are used for final rinsing. Pipettes are air dried and stored in divided drawers according to size.

A complete supply of labware and glassware is dedicated for use in the atomic absorption laboratory. Pipettes are soaked in 10% HCL solution and cleaned in a pipette washer using three volumes of tap water followed by three volumes of deionized water. Volumetric flasks and glassware dedicated to major cation analyses are rinsed three times with deionized water after each days use and air dried. Two 20% nitric acid baths are maintained in the atomic absorption laboratory; these acid baths solutions are replaced every two months using reagent

grade nitric acid. Glassware dedicated to major cations are further cleaned by soaking overnight in 20% nitric acid bath on a bimonthly basis. Glassware dedicated to trace metal analyses are rinsed with deionized water after use and are filled with deionized water which has been acidified with double distilled nitric acid for storage. Polyethylene trace metal bottles are soaked in 20% nitric acid for a minimum of 24 hours, tap water rinsed, deionized water rinsed, and stored filled with deionized water which has been acidified to approximately 1% with double distilled nitric acid purchased from GFS Chemicals, (#621).

5.2 Surface Water Sampling Procedures for Inorganics

Water samples are collected from the desired depth by means of a Van Dorn-type sampling bottle. The bottle is cleaned with sample at each new location by lowering and raising it through the water column several times. The bottle is then brought to the desired depth (generally 0.5 meters) and activated by means of a brass messenger. After closure, the sampling bottle is removed from the water and taken to a clean level spot for processing.

To facilitate sample filtration and to ensure that an adequate supply of water has been collected, the sample is transferred to a clean five liter polypropylene bucket. The bucket is rinsed twice with the sample water before the remainder is transferred to the bucket. All aliquots are taken from the same water sample.

The aliquots requiring no filtration are processed first to prevent contamination of the sample by airborne particulates or the filtering device. The polyethylene sample bottles which are obtained from the laboratory are rinsed three times with 15-20mL of sample with the cap in place and is then filled and preserved if necessary. For unfiltered bottles that require preservation the following procedures are followed. Each bottle is filled nearly to the top and the appropriate acid (Table 5-1) is added dropwise until $\text{pH} < 2$ is confirmed by testing with pH paper (range 0-2.5, sensitivity of 0.3 pH units). This is accomplished by capping and shaking the aliquot bottle after the addition of each drop of acid and pouring a very small amount of sample onto a fresh pH test strip. Once the proper pH is attained the bottle is filled to the top with sample, the cap is tightly secured, and the bottle is tagged and placed on wet ice.

Aliquots requiring filtration are removed from the bucket by means of a 50 mL polypropylene syringe which is then connected to a Millipore Swinnex-47 mm filter holder which contains a 0.45 micron Poretics polycarbonate filter and a fiberglass prefilter. The 50 ml syringe must be rinsed three times with the sample and then approximately 30 mls of sample is pushed through the loaded filter holder to remove any deionized water remaining from the loading process. Each bottle is then rinsed with 15-20 ml of filtrate and is then filled, preserved if necessary (using the same procedure as required for unfiltered aliquots) capped securely, tagged and placed on wet ice.

The type of preservation and holding times are shown in table 5-1. The bottles used for collection of the sample and the sample tags are shown in figures 5-1 and 5-2. These figures also show how the sample is aliquoted and the tests performed on each aliquot. All bottles are polyethylene and have been cleaned as described in Section 5.1. The 5 liter polypropylene buckets (and lids) are cleaned prior to the field trip with detergent (Liquinox™), rinsed three times with tap water, rinsed with 10% hydrochloric acid, rinsed three times with tap water, rinsed with deionized water and air dried. The Van Dorn sampling bottles and reusable 50 ml syringes are

Table 5-1. Sample Bottles and Preservation

Parameter	Container	Preservative	Holding Time
Physical Properties			
Color	P.	Cool, 4°C	48 Hrs.
Conductance	P.	Cool, 4°C	28 Days
pH	P.	None Req.	Analyze Immediately
Residue			
Filterable	P.	Cool, 4°C	7 Days
Non-Filtrable	P.	Cool, 4°C	7 Days
Total	P.	Cool, 4°C	7 Days
Volatile	P.	Cool, 4°C	7 Days
Turbidity	P.	Cool, 4°C	48 Hrs.
Metals			
Dissolved	P.	Filter on site HNO ₃ to pH < 2	6 Mos.
Total	P.	HNO ₃ to pH < 2	6 Mos.
Alkali Earths	P.	HCL to pH < 2	6 Mos.
Mercury			
Dissolved	P.	Filter on site HNO ₃ to pH < 2, 4°C	28 Days
Total	P.	HNO ₃ to pH < 2, 4°C	28 Days
Inorganics, Non-Metallics			
Alkalinity	P.	Cool, 4°C	14 Days
Chloride	P.	None Req.	28 Days
Fluoride	P.	None Req.	28 Days
Nitrogen			
Ammonia	P.	H ₂ SO ₄ to pH < 2, 4°C	28 Days
Kjeldahl, Total	P.	H ₂ SO ₄ to pH < 2, 4°C	28 Days
Nitrate plus Nitrite	P.	H ₂ SO ₄ to pH < 2, 4°C	28 Days
Nitrite	P.	Cool, 4°C	48 Hrs.
Phosphorus			
Orthophosphate	P.	Filter on site Cool, 4°C	48 Hrs.
Hydrolyzable	P.	H ₂ SO ₄ to pH < 2, 4°C	28 Days
Total	P.	H ₂ SO ₄ to pH < 2, 4°C	28 Days
Total Dissolved	P.	Filter on site H ₂ SO ₄ to pH < 2, 4°C	28 Days
Silica			
Sulfate	P.	Cool, 4°C	28 Days

Organics			
Purgeables	G, Teflon	Cool, 4°C	14 Days
PAH	Lined Septum	Cool, 4°C, HCl pH2	14 Days
Acrolein	Lined Septum	Cool, 4°C	3 Days
Non Purgeables	G, Teflon lined caps	Cool, 4°C, store in dark after extraction	7 days until extraction/40 days

FIG. 5-1 SAMPLE SUBMISSION DIAGRAM FOR UNFILTERED WATER

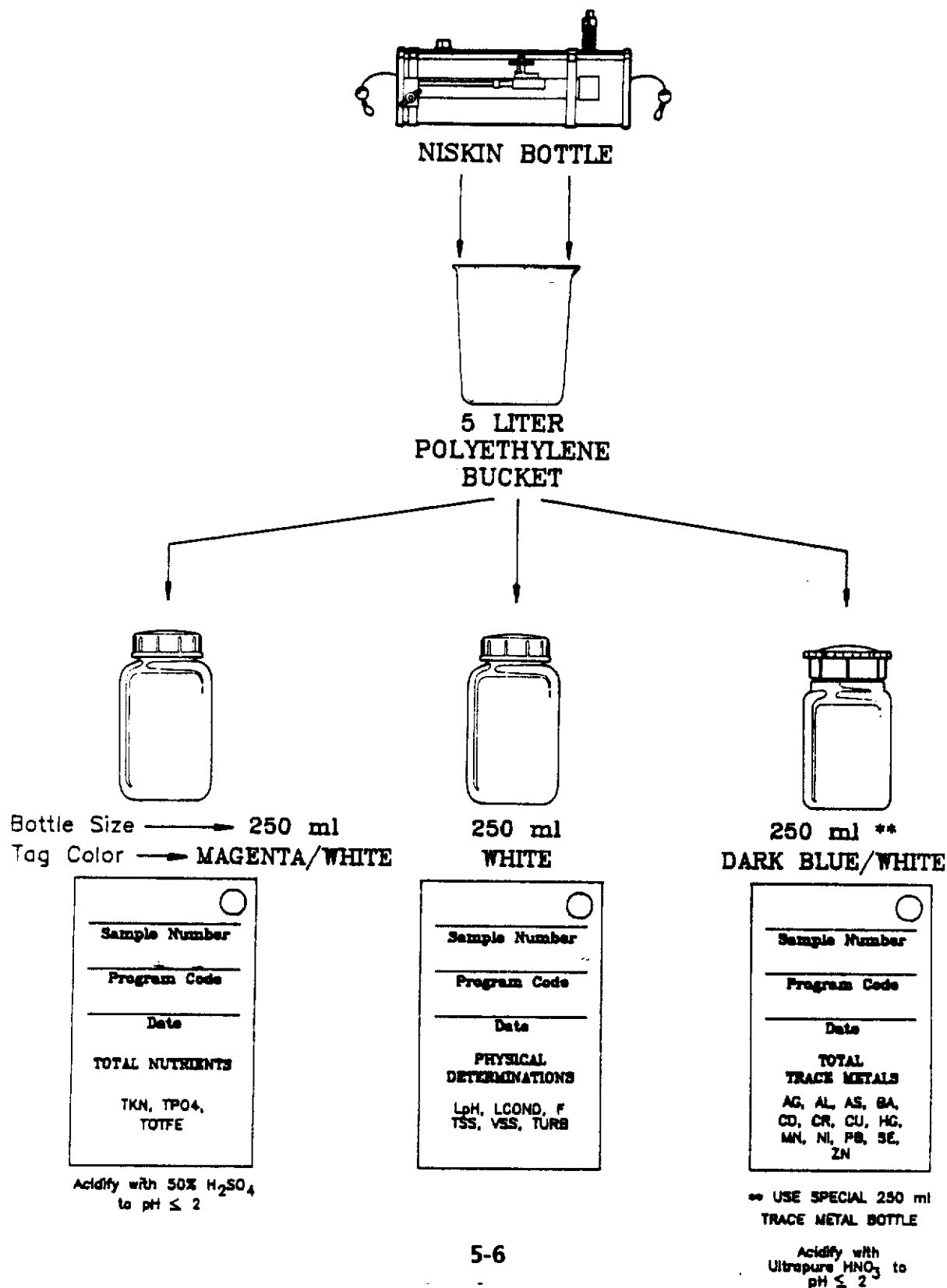
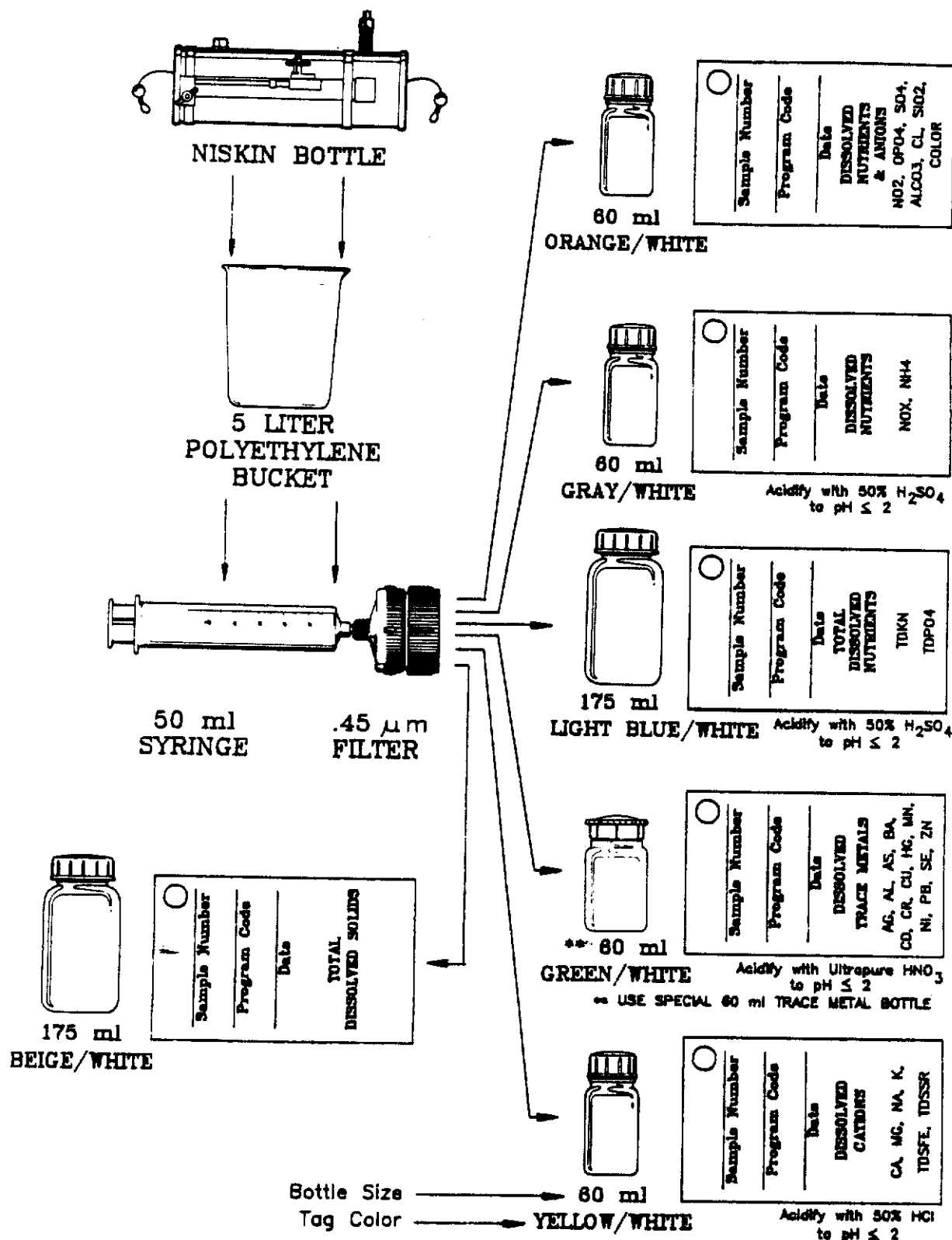


FIG. 5-2 SAMPLE SUBMISSION DIAGRAM FOR FILTERED WATER



also cleaned prior to each sampling trip in the same manner, omitting the hydrochloric acid step.

5.3 Surface Water Sampling Procedures - Organic Protocols

Surface water samples collected for organic analysis do not require any sampling equipment. Samples are collected mid-canal using a small boat or utilizing a sub-surface grab sampler. Sample containers are immersed one-half meter below the surface until full. Volatile organics are collected in 40 ml glass vials. Each container is filled to overflowing. The septum is placed Teflon-side down on the convex sample meniscus and sealed with the screw cap. To insure that the sample has been properly sealed, the vial is inverted and lightly tapped on the lid to dislodge any entrapped air bubbles. The absence of air bubbles indicates a proper seal. If air bubbles are present, the bottle is opened, additional sample added and resealed as outlined above.

Following collection of the sample, the bottles are sealed, tagged, and returned to the contract laboratory along with appropriate technique and holding times are shown in Table 5-1.

5.4 Ground Water Sampling Procedures

Determination of Well Volume

When ground water quality samples are collected, the depth to water within the well to be sampled is measured first. The total depth of the well is known from previous measurements, or well construction reports. The well volume is determined so that the volume of water to be purged can be calculated. Well volume is determined by subtracting the depth to water from the total depth of the well. This length of water (in feet) is then multiplied by the volume per linear foot for the appropriate diameter of casing. The volume per linear foot is obtained from the capacity of hole table in the "Water Well Handbook" published by the Missouri Water Well & Pump Contractors Assn., Inc.

Well Purging Procedure

After the volume of the well to be sampled is determined, the well is purged for a minimum of three well volumes using a 2-inch centrifugal pump, or a Masterflex™ peristaltic pump. **(These pumps are used for purging the well only. All samples are collected from Teflon bailers.)** Pump selection is based on the volume of the well to be purged. The 2-inch centrifugal pump is used when the well volume exceeds approximately 2.5 gallons. Both of these pumps are suction pumps and cannot be used to purge wells where the depth to water is greater than 28 feet. (None of the wells that are currently being sampled have a depth to water greater than 28 feet.)

The purging rate is determined by measuring the time required to fill a container of known volume. Flow rate is measured several times during purging to be certain that it does not change as the well is continuously purged.

The suction hose used with the 2-inch centrifugal pump is constructed of PVC. The length PVC hose that comes in contact with the water in the well is cleaned using the same procedures that are outlined below for sampling equipment. The suction hose is cleaned in the field immediately prior to purging each well.

The tubing that is used with the Masterflex pump is made of tygon. The tygon tubing that comes in contact with the water in the well is replaced at each well. This tubing is cleaned in the field immediately prior to purging the well using the same procedures outlined below for cleaning sampling equipment. Note this tubing is not used when organic samples other than TOC are to be collected. When organic samples other than TOC are collected from wells having a volume of less than 2.5 gallons the wells are purged with the teflon bailer.

The tygon tubing and PVC suction hose are kept at the top of the water column in the well during purging to make certain that there is no "dead" water remaining within the well after purging is completed. In many wells this involves "chasing" the water level down by lowering more hose as the well is drawn down during purging. The pump is turned on the entire time that the hose or tubing is inside the monitor well to insure that water from inside the hose or tubing does not drain back into the well.

pH, temperature, and conductivity are measured while the well is being purged. The well is purged until these parameters stabilize, or until a minimum of three bore volumes has been purged, whichever is greater. pH is considered to have stabilized when three consecutive readings are within a 0.2 pH unit range. Temperature is considered to have stabilized when three consecutive readings are within a 0.2° celsius range. Conductivity is considered to have stabilized when differences between three consecutive readings are less than 10% of the lowest of the three values.

After the well has been purged using the suction hose it is bailed with a teflon bailer to remove the top 5 feet of water or approximately 2.5 gallons whichever is less. This procedure is done to insure that any water that was in contact with the PVC suction hose or tygon tubing has been removed. The number of bailers of water that need to be removed from the well is determined from the capacity of hole table in the "Water Well Handbook", and from the volume of the bailer being used.

Sampling Procedures

Unfiltered water samples to be analyzed for inorganic constituents are collected using a 100 percent Teflon bailer, the sample water is transferred directly from the bailer to the sample bottle(s) (the bailer is suspended by a Teflon coated stainless steel cable). The sample bottles, tags, and methods of preservation are the same as those described for surface water sampling.

Organic samples are collected with a teflon bailer and transferred directly from the bailer into the sample container. The container is a 40 ml glass vial with a teflon coated septum. Care is taken during the sample collection process to minimize the exposure of the sample water to air. The sample water is transferred from the bailer to the sample vial by use of a bottom emptying device (100% teflon) that minimized agitation of the sample and exposure to air. The organic samples are immediately

placed on ice in a closed container. Exposure of the organic samples to sunlight is kept to a minimum. The organic samples are tagged, and all pertinent information is marked on these tags. This information includes station ID, sample number, parameters to be analyzed, date, time, and the names of the sampling crew.

When organic compounds other than TOC are collected, field blanks are kept with the organic sample bottles to make certain that the samples have not become contaminated. These field blanks accompany the samples from the time the empty sample bottles are shipped from the lab until the samples are analyzed. Field blanks account for at least 5% of the samples that are analyzed.

Filtered samples are collected using a 100 percent Teflon bailer. The bailer has been modified so that a QED Sample Pro FF-8200 High Capacity 0.45 micron filter can be attached directly to the base of the bailer. The top of the bailer has an attachment so that the bailer can be pressurized to force the water through the filter (all parts are Teflon). The first 100ml of sample water to pass through the filter is discarded as rinse water, and the last 100ml of sample water in the bailer is not used since it has been in contact with the air at the top of the bailer.

The sampling equipment (Teflon bailer and attachments) is disassembled and detergent (Liquinox™) washed, tap water rinsed, thoroughly rinsed with deionized water, rinsed twice with pesticide grade isopropanol, and double rinsed with analyte free water in the lab prior to each trip. The sampling equipment is then stored in a clean protective case.

Field cleaning procedures for the sampling equipment varies with the analytes that are being collected:

1. Inorganic samples only (no trace metals, no organic samples other than TOC)

The sampling equipment is washed with Liquinox™ detergent, thoroughly rinsed three times with analyte free water and allowed to air dry at each site prior to sample collection.

2. Inorganic samples and trace metal samples (no organic samples other than TOC)

The sampling equipment is washed with Liquinox™ detergent, thoroughly rinsed twice with analyte free water, rinsed with 1 + 1 hydrochloric acid, thoroughly rinsed twice with analyte free water and allowed to air dry immediately prior to sample collection.

3. Organic and trace metal samples

The sampling equipment is washed with Liquinox™ detergent, thoroughly rinsed twice with analyte free water, rinsed with 1 + 1 hydrochloric acid, thoroughly rinsed with analyte free water, rinsed twice with pesticide grade isopropanol, thoroughly rinsed with analyte free water and allowed to air dry immediately prior to sample collection.

At a minimum the first three bailers collected from the well are discarded to further rinse the bailer. After each site has been sampled, the bailer is rinsed with deionized water, dried, and stored in a clean protective storage case to prevent atmospheric contamination.

The sampling personnel wear disposable gloves when collecting samples to avoid contamination while handling the sampling equipment.

The bottles for organic sample collection are supplied ready to use by the contract laboratory which will be doing the analysis. The bottle has been cleaned according to their approved QA procedures, sealed, and delivered to the SFWMD. Following collection of the sample, the bottles are sealed, tagged, and returned to the contract laboratory along with appropriate sample identification and chain of custody.

Field QC checks are performed for a minimum of 5% of the samples collected. These QC checks consist of the collection of the routine sample, a split sample, a field spiked sample, a field blank, a field spiked blank, a replicate sample and an equipment blank.

Ground water quality samples are preserved using the same protocols described in the surface water sampling section of this plan.

Automatic samplers are not used by the SFWMD for the collection of ground water quality samples.

5.5 Soil/Sediment Sampling Procedures

Organic Protocols

Soil/sediment samples collected for organic analysis are collected by hand grab using a stainless steel trowel or a stainless steel petite Ponar™ dredge. Field equipment (dredge or trowels) are cleaned prior to the field trip and after each sample using the following procedures. Field equipment is cleaned with tap water and detergent (Liquinox™), rinsed three times with tap water, rinsed twice with pesticide grade isopropanol, rinsed with analyte-free water and allowed to air dry.

Trace Metals Protocols

Soil/sediment samples collected for trace metal analysis are collected by hand grab using a stainless steel trowel or a stainless steel petite Ponar™ dredge. Field equipment (dredge or trowels) are cleaned prior to the field trip and after each sample using the following procedures. Field equipment is cleaned with tap water and detergent (Liquinox™), rinsed three times with tap water, rinsed twice with pesticide grade isopropanol, rinsed with analyte-free water and allowed to air dry.

6.0 Sample Custody

The custody of the sample from the time of collection to the time of disposal is an essential part of the quality control program. Samples analyzed by the SFWMD laboratory and laboratories under contract to the SFWMD are collected by trained SFWMD sampling personnel.

6.1 Laboratory Operation

The laboratory Data Entry Technician is responsible for entering the information from the CHEMISTRY FIELD DATA LOG sheet into the laboratory's Perkin-Elmer LIMS 2000 computer. The screen used to enter the data is shown in Figure 6-1. The computer generates an eight digit laboratory sample number for each sample. A bar code label is printed for each aliquot of a sample. The bar code label contains the LIMS sample number and a listing of all tests to be performed on the aliquot. Sample bar code labels are shown in Figure 6-2. The Data Entry Technician attaches the bar code label to the field sample label, sorts the bottles by aliquot and LIMS sample number, and returns them to the refrigerator.

The LIMS computer tracks the progress of the sample through the lab. The person responsible for a test gets a list of samples to be analyzed from the computer on a daily basis. The sample maintains a status of Logged-In until one of the tests is completed at which time the status is changed to In-Process for the sample. Each test or analysis maintains a status of Logged-In until the result has been entered into the computer. A sample of the status screen is shown in Figure 6-3. When all tests have been completed on a sample, the sample status is updated automatically to Complete.

Weekly updates of results are sent to both the project managers and the Supervising Professional-Chemist for review. Any deviations are noted and samples requiring rework are identified as such in the computer. Samples are held for one week following completion of all analyses to allow for final data review by project managers. If re-analysis is requested by the project manager, the test is given priority and the sample is held an additional week. After this week, the formal chain of custody ends when the results are archived and the samples are removed from the refrigerators for disposal.

The samples are accessible to the laboratory staff during working hours. The door to the exterior of the building and the door to the main hallway are locked when the last member of the lab staff leaves for the day. The door to the sample receiving area is opened at 7:00 A.M.. The only persons authorized to be in the laboratory are the laboratory staff and the sampling personnel. All visitors must be escorted by a member of the laboratory staff.

6.2 Field Operations

The sample collection personnel fill out a CHEMISTRY FIELD DATA LOG sheet at the time of sample collection which provides information on the sampling conditions. This form is shown in Figure 6-4. This form is submitted to the laboratory along with the samples. The sample collection personnel are responsible for sorting the samples based on the field number and putting them into the refrigerator designated for incoming samples upon their return from the sampling trip.

Note the following description is intended to document the chain of custody procedures for samples that are collected for research purposes. The SFWMD does not presently ship any compliance monitoring samples to external laboratories. If compliance monitoring samples are sent to external laboratories in the future, the chain of custody procedures will be documented in the program specific QA/QC plan.

No sample seals are used for samples analyzed by the SFWMD laboratory. Samples to be analyzed by contract laboratories are shipped on ice in sealed coolers by overnight courier services. The sample containers are marked by two different methods depending upon the contract laboratory and the type of analyses requested. Sample containers are either marked directly with indelible ink on labels that were affixed to the sample containers at the contract laboratory prior to shipment of the bottles to the SFWMD, or the sampling personnel attach an SFWMD tag to the sample container. The following information is written on all sample bottles; program code, sample ID number, site location, collector (individual and agency), date of collection, preservative, and analyses requested. In addition a copy of the SFWMD Chemistry Field Data Log sheet is also enclosed in the sealed cooler.

When the results are received from the external lab the sample identification number, station identification code, date and time that the sample was collected are all listed with the results of the analyses. This information allows the SFWMD to accurately track all samples and analytical results.

SOUTH FLORIDA WATER MANAGEMENT DISTRICT LIMS/2000

ENTER

PAGE 01

01 - SAMPLE NUMBER : 87003972

03 - PROJECT CODE : _____

04 - C/LAS TYPE : _____

05 - PROJECT CODE : _____

06 - SUBMITTER : _____

07 - CHARGE NUMBER : _____

08 - FIELD SAMPLE NUMBER : _____

09 - DATE COLLECTED : _____

02 - PRIORITY : _____

10 - TIME COLLECTED : _____

11 - STATION CODE : _____

12 - UP/DOWN STREAM : _____

13 - DISCHARGE : _____

14 - WEATHER : _____

18 - DISSOLVED OXYGEN : _____

15 - SAMPLE TYPE : _____

19 - SPEC. CONDUCTIVITY : _____

16 - DEPTH : _____

20 - PH : _____

17 - TEMPERATURE : _____

21 - SECCHI DISC : _____


22 - SAMPLE DESCRIPTION : _____

23 - PERMIT NUMBER : _____

Figure 6-1. LIMS Sample Log-In Screen


Figure 6-2. Example Bar Code Labels

TSS TURB VOL1 USS
LCOND LPH SSUT1 SSUT2 SSUT3 TKN TP04




#87002204# ALIQUOT 1

NH4 OP04 S04 COLOR ALCO3 CL



#87002204# ALIQUOT 2

TOTZN TOTCU



#87002204# ALIQUOT 6

Figure 6-3. Example LIMS Sample Status Screen

SOUTH FLORIDA WATER MANAGEMENT DISTRICT LIMS/2000 SET STATUS

SAMPLE NUMBER : 87002009
 OTE : 04/08/87 06:52:53 OTM : 04/09/87 15:16:53
 PRIORITY : 0
 STATUS HIST : 51000000
 STATUS : IN-PROCESS

STATUS SELECTIONS REQUIRED ANALYSIS (030)

ITEM	ITEM	ANALYSIS	STATUS	HISTORY
1 - LOGGED-IN	1 - TURB		LOGGED-IN	10000000
2 - ON HOLD	2 - SSWT1		COMPLETE	71000000
3 - REJECTED	3 - COLOR		COMPLETE	71000000
4 - HELP REQUESTED	4 - ALC03		LOGGED-IN	10000000
5 - IN-PROCESS	5 - SSWT1		COMPLETE	71000000
6 - RE-WORK	6 - TOTMG		LOGGED-IN	10000000
(7 - COMPLETE)	7 - NH4		COMPLETE	71000000
(8 - RELEASED)	8 - SSWT2		COMPLETE	71000000
(9 - CANCELLED)	9 - VOL1		COMPLETE	71000000

ENTER ANALYSIS ITEM NUMBER : ____

FIG. 6-4 Chemistry Field Data Log

PROJECT TEST LIST	
Sample type: b blank for routine, 1 rainwater, 2 well water, 3 seawater, 4 profile 5 diet, 7 composite on time, 8 composite on depth, 9 control, 24 composite on flow proportional	
PERMIT NUMBER	

[illegible]

The above samples are to be analyzed for the following parameters (please circle)

15	EPH	13	COLOR	91	ALCO3	78	NOX	30	CA	180	TOIAG	102	TOIHO	57	TDSAG	48	TDSHG
14	LCONAD	23	OP04	32	CL	26	TP04A	31	MG	66	TOTAL	116	TOIIN	38	TDSAL	48	TDSHG
12	TURB	19	NO2	27	SI02	20	NH4	26	NA	108	TOIAT	116	TOIIN	40	TDSAL	50	TDSHG
16	ISS	17	YSS	36	TOTFE			29	K	108	TOIAT	107	TOIPB	41	TDSRA	46	TDSHP
17	YSS							53	TDSRHR	102	TOICD	101	TOTSE	42	TDSRD	51	TDSSE
15								37	TDSFE	72	TOICR	108	TOIZN	43	TDSCR	54	TDSZN
										104	TOICR						

Requisitioned By (Signed)	Date	Time	Received in Good Condition By (Signed)	LMS Numbers	Date

7.0 Calibration Procedures and Frequency

Calibration of all instrumentation used in the field and laboratory is an integral part of the quality assurance program.

7.1 Field Instrument Calibration

The Hydrolab Model 4000 or Model Surveyor II is calibrated the morning of the field trip. The dissolved oxygen calibration is determined from an oxygen solubility table.* A calibration cup containing tap water is placed on the end of the Hydrolab sonde. The dissolved oxygen probe is calibrated from the water saturated air inside the calibration cup. The temperature of the water is determined from the Hydrolab's temperature probe and the appropriate dissolved oxygen solubility is determined from the table. The dissolved oxygen probe on each unit is calibrated against the Winkler method on a quarterly basis (following routine maintenance). The temperature probe can only be adjusted in the factory but is calibrated on a quarterly basis using a NBS calibration thermometer. The specific conductance probe is calibrated by filling the calibration cup with a conductance standard (either 720 or 1490 $\mu\text{mhos/cm}$) and the Hydrolab is adjusted to that value. The pH probe is calibrated using pH7 solution purchased from Fisher Scientific; pH4 and pH10 purchased solutions are used to adjust the slope if necessary.

Calibrations notes for all field instrumentation (hydrolabs) are kept in a bound notebook. This information is in the format shown below:

Temperature Read	_____	Name:	_____
Dissolved Oxygen*	_____	Date:	_____
Dissolved Oxygen reads	_____	Time:	_____
Adjusted To	_____	Hydrolab #:	_____
		Initial:	_____
Conductivity Standard Used:	_____		
Conductivity Read	_____		
Adjusted To	_____		
pH 7.00 used	_____		
pH Read	_____		
Adjusted To	_____		
pH 4.00 or 10.00 Used	_____		
pH Read	_____		
Slope Adjusted To	_____		
Stirrer Working	Yes _____ No _____		
Battery Voltage Read	_____		

*Reference: Hydrolab Digital 4041 Operation and Maintenance Instructions, 1981.

7.2 Laboratory Instrument Calibration

Each laboratory instrument is calibrated according to the manufacturer's instructions. A brief description for each instrument is provided. With the exception of the analytical balances, all analytical instruments are calibrated before each analytical run. The frequency of recalibration is stated after each type of instrumentation.

- A. Analytical Balances - The analytical balances are cleaned, serviced and calibrated every six months by a professional balance service. Class S weights are available for in-house calibration as needed; balance calibration is checked on a monthly basis.
- B. Spectrophotometers - The spectrophotometers are calibrated with a blank and four standard solutions prior to each use. The absorbance of the high standard is compared to that of previous values. Wavelength calibration is checked against a series of Chemetric Spectro Standards as necessary. Recalibration frequency during analyses: every 30 samples. Daily calibration information is recorded in concentration units on the Calibration Log for Physical Parameters.
- C. Flow Injection Analyzer - The Lachat Flow Injection Analyzer is calibrated with a blank and at least four standard solutions prior to each use. The GAIN setting is compared to that of previous values. Recalibration frequency during analyses: every 30 samples. Daily calibration information is recorded in peak height readings on the FIA Sample Log form.
- D. pH Meter - The pH meter is calibrated with pH 4.00, 7.00, and 10.00 solutions prior to each use. Recalibration frequency during analyses: every 30 samples. Daily calibration information is recorded in pH units on the Calibration Log for Physical Parameters.
- E. Conductivity Meter - The conductivity meter is calibrated with a known conductivity solution prior to use. Each range is checked for linearity with an appropriate standard solution. Recalibration frequency during analyses: every 30 samples. Daily calibration information is recorded in $\mu\text{S}/\text{cm}$ on the Calibration Log for Physical Parameters.
- F. Turbidimeter - The turbidimeter calibration is checked with preserved Gelex Secondary turbidity Standards (purchased from HACH Company) before each use. A primary 40 NTU standard is freshly prepared from 4000 NTU Formazin standard and used to calibrate the turbidimeter on a quarterly basis. Recalibration frequency during analyses: every 30 samples. Daily calibration information is recorded in NTU on the Calibration Log for Physical Parameters.

- G. Atomic Absorption Spectrophotometer - The flame AAS is calibrated using a blank and a minimum of four standard solutions prior to use; recalibration frequency during analyses: every 15 samples. The graphite furnace AAS is calibrated using a blank and three standard solutions; recalibration frequency during analyses: every 15 samples. The absorbance of all standards are compared to acceptable ranges based on parameter-specific historical values. Daily calibration information is recorded in absorbance units on the Atomic Absorption Analysis Log.
- H. Ion Chromatograph - The ion chromatograph is calibrated prior to use using three standard solutions; recalibration frequency during analyses: every 35 samples. Retention times for each standard peak are compared to historical values. Daily calibration information is recorded in peak area in minutes on the Calibration Log.
- I. Rapid Flow Analyzers - The Alpkem Rapid Flow Analyzers are calibrated with a blank and four standard solutions prior to use. The GAIN setting is compared to that of previous values. Recalibration frequency: every 30 samples. Daily calibration information is recorded in electronic units on the RFA Log form.

7.3 Calibration Standards

The calibration standards are obtained from a variety of sources.

Atomic absorption standards for metals are purchased from the National Institute of Standards and Technology, Gaithersburg, MD, 20899; NIST assays each lot and lists the actual concentration of the stock solution.

Turbidity standards are obtained from Hach Company, P.O. Box 389, Loveland, CO 80539. Both the gel standards and the formazin are purchased from Hach.

Conductivity standards are obtained from Markson Science, 7815 S. 46th St., Phoenix, AZ 85044-5114. Standards are available for a variety of levels which allow the calibration of each range of the meter. The conductivity meter is calibrated quarterly using a freshly prepared solution made from dried ACS reagent grade KCl.

pH 4.00, 7.00, and 10.00 solutions are purchased from Fisher Scientific.

Calibration standards for the colorimetric procedures are prepared in the laboratory from ACS reagent grade chemicals. The primary color standard is Platinum Cobalt Color standard purchased from Fisher Scientific.

The water used in the laboratory is treated by filtration, softening, activated carbon, reverse osmosis, activated carbon, deionization and filtration through a 0.22 micron filter. The water is then Type I water with a resistance of at least 18 megohms.

The date of preparation of in-house primary stock solutions are recorded in a logbook along with the following information regarding purchased stock solutions: element, concentration, supplier, date opened, expiration date and date of disposal. Only one bottle of each purchased analyte stock solution may be open at one time; purchased stock solutions are replaced according to expiration date or sooner if the volume is depleted.

Primary stock solutions prepared from freshly dried salts in the laboratory are refrigerated and replaced monthly; records of these activities are kept in a logbook.

Working calibration standards for all analytes are prepared fresh for each days' analyses; the information recorded in the stock solutions logbook is used to document the source of the primary stock solutions from which the working calibration standards are prepared.

7.4 Laboratory Instrument Calibration Records

Instrument calibration with primary standards is recorded in a bound notebook maintained by the Laboratory Quality Assurance Officer. Instrument response to calibration standards are recorded by the analyst on a daily basis in the instrument-and-analysis-specific logbooks. Examples of the forms that make up each logbook are provided in Section 10. The means of recording daily calibration information for each instrument is given in Section 7.2.

8.0 Analytical Procedures

The procedures used in this laboratory are from the EPA approved method list found in 40 CFR Ch. 1, Part 136, (7-1-88 Edition). The specific reference for each method can be found in Section 4.0 of this QA Plan.

8.1 Modified Procedures

1. **Color:** The method for color has been modified for use in the SFWMD laboratory. The samples submitted to this laboratory are from natural, surface, and ground water sources within the boundaries of the South Florida Water Management District.

The color in the samples is due primarily to vegetative decay and not from industrial waste. It has been determined that measurement of color at 465 nm gives results comparable to those measured visually by technicians. Use of the spectrophotometer eliminates the natural variation in color perception found in the human eye allowing the lab to consistently report results regardless of which technician performs the analysis. The procedure used in the laboratory is given in Appendix A.

2. **Sulfate:** All sulfate samples are analyzed using ion chromatography; these samples range from rain water to groundwater. A complete description of the method used is given in Appendix B. Additional information provided shows a comparison of results obtained by EPA method 375.2 versus ion chromatograph results. Also included are results obtained on USGS round robin samples and field QC results. Each sampling trip includes field spike samples and field spike blanks; the results of the field spike samples are closely scrutinized as they are indicative of the accuracy of the method for various matrices.

9.0 Data Reduction, Validation and Reporting

9.1 Data Reduction

Data reduction is done using microprocessors in the instruments or computer programs which convert raw data into appropriate reporting units. Raw or converted data (depending on the instrument) is input to the laboratory information management system as it is generated by the laboratory staff. Field data is not reduced; it is stored in the format used in the LIMS Sample Log-In, Figure 6-1. A flowchart of the laboratory information management system is shown in figure 9-1.

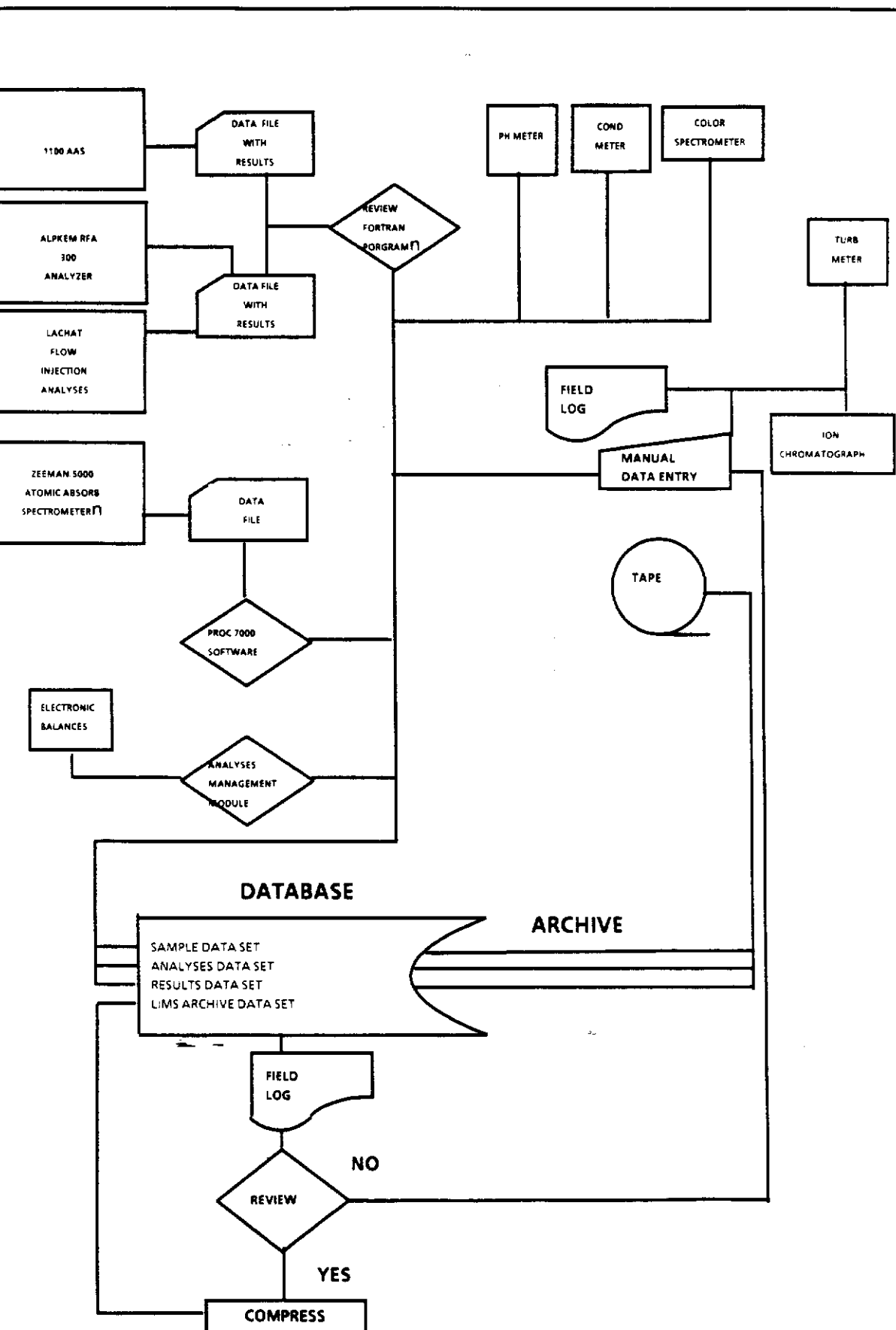
9.2 Data Validation

The criteria used for the validation of data are the following:

1. Results of the daily quality control samples, instrument sensitivity, calibration curves, and results of continuing calibration are checked by the analyst and must fall within acceptable limits based on parameter-specific historical data. Daily quality control results include a minimum of two external check standards (called QC1 and QC2), two repeat sample readings, and one standard addition ("spiked") sample. Standard additions are not prepared for physical parameters.
2. Reversal of test results, i.e. orthophosphate greater than total phosphate, dissolved copper greater than total copper, etc.
3. Project manager's knowledge of the sample and/or historical values for routine monitoring programs.

The validation of data is accomplished in five steps. The results are reviewed initially by the technician performing the analysis to spot any obvious analytical outliers. Second, the results are reviewed by the laboratory supervisor or senior chemist for reversals and any other obvious analytical outliers. Third, the daily quality control results are reviewed by the Quality Assurance Coordinator. Fourth, the results are reviewed by the project manager from the perspective of his/her knowledge of the sample. Fifth, the results are again reviewed by the laboratory supervisor or senior chemist after completion of all tests and reruns. Steps two through four may be accomplished at any time the sample is undergoing analysis. Outliers are treated by rerunning the test after identification of a possible error at any one of the four reviews. Most analytical outliers are obvious such as those described in the second criteria for the validation of data. Other outliers are results found to be far from expected values which are based on review of historical data; assessment of outliers of this type is handled by the project manager who then decides if resampling is necessary. After the final review, the results for completed samples are archived by the Laboratory Data Systems Supervisor and become part of the laboratory data base.

g. 9-1



Approximately ten percent of all manually entered analytical results and field information is randomly checked for accuracy by the Laboratory Quality Assurance Officer. The Data Systems Supervisor checks information on each sample once it has been logged in on a daily basis. Manually entered data becomes part of the database and is further reviewed by the process described in the preceding paragraph.

Organic analyses are performed by contract laboratories in accordance with that laboratory's approved quality assurance plan. Review of all contract laboratory data is the responsibility of the program manager.

Key individuals who are responsible for data in the reporting scheme are:

1. **Project manager:** A professional scientist/engineer responsible for the design and scheduling of the sampling program. He/she is responsible for coordinating with the laboratory and the review of all data associated with the project before archival.
2. **Field Technician:** Person responsible for the collection and preservation of the samples. He/she fills out the field log sheet at the time of sampling to provide accurate identification of the sample and recording of results for field measurements.
3. **Laboratory Supervisor or Senior Chemist:** Responsible for the review of all analytical results prior to release to the project manager and the final review of data prior to archiving.
4. **Laboratory Data System Supervisor:** Responsible for processing, distribution, and storage of all data associated with the laboratory analyses, maintenance of the system hardware and software used with the Perkin-Elmer LIMS 2000 data base.
5. **Laboratory Technician or Analyst:** Responsible for the analysis of samples, preliminary review of results and updating of the data base.
6. **Data Entry Technician:** Responsible for the manual entry of data from the field log sheets and laboratory data input forms.
7. **Quality Assurance Coordinators:** Field coordinator is responsible for the proper collection of the samples. Lab coordinator is responsible for the reviewing of the daily quality control sample results and preparation of performance quality control samples for both the field and lab.

9.3 Data Reporting

Reports of all data contained in the laboratory data base can be obtained by the project manager at any time. All data generated by the SFWMD laboratory is part of the public domain. All requests for data reports must be made to the appropriate project manager.

10.0 Field and Laboratory Quality Control Checks

Quality control procedures are those steps taken by the laboratory and field staffs to insure that the required precision, accuracy, and reliability levels are maintained. The Laboratory Quality Assurance Manual and the Field QC Sampling Manual are tools crucial to new personnel training.

10.1 Field Quality Control Checks-Inorganics

The field quality control check samples consist of the following:

- A. Field Blank - a deionized water sample which has been treated in the same manner as the samples; also known as "trip blanks."
- B. Field Spiked Blank - similar to a Field Blank except that a discrete volume of spiking solution containing known amounts of each analyte in question is added. Spike solutions are purchased from Environmental Resource Associates, Arvada, Colorado, and Hach Company, Loveland, Colorado.
- C. Field Spiked Sample - this is an actual sample taken from the field which has spiking solution identical to that used for preparing field spiked blanks is added in the field.
- D. Replicate Sample - two or more samples collected simultaneously from the same sampling site.
- E. Split Sample - One sample which has been divided to make two samples which are analyzed by the laboratory.
- F. Equipment Blank - after field cleaning of sampling equipment, the final deionized water rinse is collected and analyzed as an equipment blank.

The field quality control check samples described in A-E are included for each group of samples within the same project and are submitted each day samples are taken. This sampling frequency represents approximately 5% of all samples collected. These samples are prepared in the field and submitted to the laboratory with the routine samples for that project. Equipment blanks (F) are submitted and analyzed when sampling equipment is cleaned in the field and represent approximately 5% of the samples collected on those trips.

Preparation of Spiking Solutions

Spiking solutions for use in preparing field quality control check samples are prepared by the laboratory QA officer. Solutions are prepared as requested by the project manager. The left-hand margin of the Field QA/QC Sample Request Form,

shown in Fig. 10-1, is a check list of analytes for which spiking solutions have been requested. The spiking solutions are prepared using the stock solutions (purchased or prepared in-house) used to make daily calibration standards and quality control samples for laboratory QA activities. The documentation of these solutions is described in Section 7.3.

Separate spiking solutions are prepared for each aliquot of the sample; the sample aliquots and their respective bottle size, preservation technique and tagging scheme is shown in Fig. 5-1. Portions of stock solutions for each analyte within a given aliquot are pipetted and combined in a 20ml Kimax test tube with Teflon-lined screw-cap. The volumes of stock solutions used in preparing the spiking solutions are calculated so the amount of added analyte in the resultant spiked aliquot falls between the detection limit and the highest calibration standard of the respective analytical methods. The combined volume of stock solutions for each sample aliquot is designed to represent less than 5% of the sample bottle volume. Two sets of spiking solutions are prepared identically for each aliquot, one for the spiked sample and one for the spiked blank. A crucial aspect of this program is the use of the correct size bottle for sample collection. The bottle must be filled completely so the final dilution of the spiking solution is consistent. [To establish the full-bottle volume of each size and type of bottle prescribed for sample collection, 10 randomly chosen bottles of each size and type were filled to full-volume. The volume of deionized water was measured using suitable sized graduate cylinders. The ten volumes obtained for each bottle within its group were used to calculate a mean bottle volume for each size and type bottle.] Shown below are the mean bottle volumes of sample bottles used for collection:

Bottle Size	Mean Bottle Volume, n = 10
60mls	71mls
175mls	189mls
250mls	289mls
60mls, metals only	66mls
250mls, metals only	266mls

Once all solutions representing the requested analytes have been combined in test tubes, the tubes are capped and parafilm is wrapped around the seal to prevent the lids from coming lose during transport to the field. Spiking solutions are prepared the day before the trip date and refrigerated until departure time. During the sampling trip, the spiking solution test tubes are kept secure in a beaker in an ice chest.

10.2 Field Quality Control Checks - Organic Surface Water Protocols

The field quality control check samples consist of the following:

- A. Field Blank - a deionized water sample which has been treated in the same manner as the samples; also known as "trip blanks".
- B. Spiked Blank - similar to a Field Blank except that a discrete volume of spiking solution containing known amounts of analytes in question is added. Spike solutions are purchased from Environmental Resource Associates, Arvada, Colorado.

FIELD QA/QC SAMPLE REQUEST FORM EFFECTIVE 10/20/89

This form is to be completed by project manager and returned to L. Teets A MINIMUM OF ONE WEEK PRIOR TO THE TRIP DATE.

PROJECT CODE :
SAMPLING TRIP DATE :

PROJECT MANAGER :
DEPARTURE TIME :

ANALYSES REQUESTED: check only those parameters that apply; spike solutions are not prepared for physical parameters.

250 ml BOTTLE/WHITE TAG:

_____ F = 0.67

LAB USE ONLY**LOT# OR STOCK PREP:**

(2.0ml)(100mg/L HACH)/299mls

250 ml bottle/MAGENTA TAG:

_____ TKN = 3.34

(1.0ml)(1000mg/L STOCK)/299mls

_____ TPO4 = 0.502

(6.0ml)(25mg/L HACH)/299mls

_____ TOTFE = 0.42

(2.5ml)(50mg/L HACH)/299mls

175 ml bottle/LT. BLUE TAG:

_____ TDKN = 2.38

(3.0ml)(150mg/L HACH)/189mls

_____ TDPO4 = 0.396

(3.0ml)(25mg/L HACH)/189mls

60 ml bottle/GRAY TAG:

_____ NOX = 0.169

(1.0ml)(12mg/L HACH)/71mls

_____ NH4 = 0.35

(0.5ml)(50mg/L HACH)/71mls

60 ml bottle/ORANGE TAG:

_____ OPO4 = 0.352

(1.0ml)(25mg/L HACH)/71mls

_____ ALCO3 = 112.7

COMPOSITE

_____ CL = 112.7

(0.8ml)(10.000mg/L
5.000mg/L SO4)/71 mls

_____ SO4 = 56.3

*SEE REVERSE **SI02** = 7.04

(2.0ml)(250mg/L ^{HACH} Si02)/71 mls

60 ml bottle/YELLOW TAG:

_____ CA = 28.2

(2.0ml)(1000mg/L SPEX)/71 mls

_____ MG = 14.1

(1.0ml)(1000mg/L SPEX)/71mls

_____ NA = 28.2

(2.0ml)(1000mg/L SPEX)/71 mls

_____ K = 3.52

(0.25ml)(1000mg/L SPEX)/71 mls

_____ TDSFE = 0.282

(2.0ml)(10mg/L HACH)/71 mls

_____ TDSSR = 1.41

(0.1ml)(1000mg/L SPEX)/71 mls

SOLUTIONS PREPARED BY:

10-3

DATE:

LAB USE ONLY

LOT # OR STOCK PREP DATE:

250ml TM bottle/BR. BLUE TAG:

_____ **TOTAG =**
 _____ **TOTAL = 18.8**
 _____ **TOTAS = 18.8**
 _____ **TOTCD = 4.7**
 _____ **TOTCR = 18.8**
 _____ **TOTCU = 18.8**
 _____ **TOTHG = 0.94**
 _____ **TOTMN = 18.8**
 _____ **TOTNI = 18.8**
 _____ **TOTPB = 18.8**
 _____ **TOTSE =**
 _____ **TOTZN = 394.7**

0.5ml of EPA Composite

EPA + (4.0ml)(25mg/L HACH)/266mls

60 ml TM bottle/GREEN TAG:

_____ **TDSAG =**
 _____ **TDSAL = 15.2**
 _____ **TDSAS = 15.2**
 _____ **TDSCD = 3.8**
 _____ **TDSCR = 15.2**
 _____ **TDSCU = 15.2**
 _____ **TDSHG = 0.76**
 _____ **TDSMN = 15.2**
 _____ **TDSNI = 15.2**
 _____ **TDSPB = 15.2**
 _____ **TDSSE =**
 _____ **TDSZN = 356.1**

EPA Composite diluted

1 to 10; then 1.0ml of the solution
in each tube

EPA + (0.9ml)(25mg/L HACH)/66mls

SOLUTIONS PREPARED BY:

10-4

DATE:

*NOTE: Spikes prepared with SiO₂ will affect ALCO₃; ALCO₃ = 124.4 when 7.04mg/L SiO₂ is added.

$$\left\langle (7.04 \text{ mg/L SiO}_2) \frac{100.09 \text{ g/mole CaCO}_3}{60.1 \text{ g/mole SiO}_2} = 11.72 + 112.7 = 124.4 \right\rangle \text{ Composite}$$

- C. Replicate Sample - two or more samples collected simultaneously from the same sampling site.

The field quality control check samples described in A-C are included for each group of samples within the same project and are submitted each event. This sampling frequency represents approximately 5% of all samples collected. Equipment blanks are not used for surface water sampling as no field equipment is utilized.

10.3 Field Quality Control Checks - Organic Soil/Sediment Protocols

The field quality control check samples consist of the following:

- A. Field Blank -a deionized water sample which has been treated in the same manner as the samples for volatile organic method groups only.
- B. Replicate Sample - two or more samples collected simultaneously from the same sampling site.
- C. Equipment Blank - after field cleaning of sampling equipment, the final analyte-free water is collected and analyzed as an equipment blank.

The field quality control check samples described in A-C are included for each group of samples within the same project and are submitted each event. This sampling frequency represents approximately 5% of all samples collected.

10.4 Laboratory Quality Control Checks

The laboratory uses a variety of QC procedures dependent on the instrument in use and the test being performed. Factors that help make up the laboratory quality assurance plan are as follows:

- A. Standard curve - a standard curve is generated for each applicable test and is composed of a deionized water blank and at least three standard solutions. Described in Section 7.2 is the means by which daily calibration information is recorded as well as the actual number of standards used for each type of instrumentation. Analysts compare instrument response (in various units) on a daily basis to the response that has been historically obtained on the same instrument for that parameter; deviation is handled as described in Section 14.0 Corrective Action.
- B. Reagent checks - the comparison of analytical values obtained when deionized water is passed through the analytical system and when the reagent stream is passed through the analytical system.
- C. Quality Control samples - samples which have been obtained from an external source or prepared in the laboratory for which a "true" value is known. As much as possible, two quality control samples, known as QC1 and QC2, are available for each parameter. The concentrations of these samples are designed such that one QC falls near the lowest calibration standard while the other QC falls in the higher end of the calibrated range.

- D. Spiked samples - samples to which a known quantity of concentrated standard solution has been added. The results of the spiked sample and the unadulterated sample are calculated to yield per cent recovery values; these samples known are as standard addition samples to differentiate them from samples spiked in the field.
- E. Replicates - a routine sample which is analyzed repeatedly throughout an analytical run. These results are known as repeat sample values and are used to calculate a %RSD for each analytical run.
- F. Standard Check samples - these samples are of known concentration which are processed through a sample preparation protocol. Prior to preparation, the analyte is present in a form that is not detected by analysis. These samples are used to test the efficiency of certain types of sample preparation such as digestion (in the case of Kjeldahl nitrogen) and reduction (as in the case of nitrite-nitrate analyses).
- G. Digestion Duplicates - two separate aliquots of a sample which requires digestion prior to analysis are digested, analyzed and the results compared; values within 10% of each other are considered acceptable and are used to monitor the precision of the sample digestion procedure.

The frequency with which each type of QC or control sample is analyzed for each parameter is shown in Table 10.1. These frequencies were established taking the following factors into consideration: EPA guidelines and certification requirements, instrumentation, automation, the laboratory's historical performance, and the different matrices analyzed by our laboratory. [It should be noted the differences in sample matrices analyzed in the laboratory are very small; the matrices are limited to ambient surface and groundwater, rainfall and agricultural storm water runoff. Complex, diverse matrices such as municipal industrial wastewater, hazardous wastes, drinking water, soils, sediments, or plants are not analyzed by the laboratory.]

The Laboratory Quality Assurance Officer is responsible for reviewing all quality control data, providing the technicians with the appropriate QC check samples, training the technicians in the standard QC procedures, and preparing the laboratory quality assurance reports.

The QC check samples are obtained from a variety of sources which include the following:

United States Environmental Protection Agency
Hach Company
National Institute of Standards and Technology
Markson Scientific
United States Geological Survey
Environmental Resource Associates
Fisher Scientific
SPEX Industries, Inc.

Other activities important to the laboratory quality control procedures are the monitoring of instrument response which is documented on daily logs and the readings obtained on digested blanks. For colorimetric methods, the digested blank and standards are passed through the analytical system prior to the analyses to compare instrument response to historical values. If there is less than 10% deviation from the historical values the instrument response is considered acceptable. The digested blank and standards are again analyzed at the beginning of the run for calibration purposes. Digested blank for atomic absorption methods are handled in a similar manner. A deionized blank, a digested blank, and in the case of the graphite furnace, an air blank, are analyzed prior to calibration. The absorbance values for each of these should differ by no more than 5 absorbance units for flame analysis and by no more than 10 absorbance units for furnace analysis. Greater deviations warrant investigating possible instrumentation and digestion contamination. Detection limits for atomic absorption analyses were calculated based on the deviation of repeat absorbance readings of the lowest calibration standard for each parameter. Three times the standard deviation was defined as the detection limit; two years of detection limits obtained in this manner were compiled and used to assign a detection limit value to each parameter.

Other "logs" not shown are computer software files used to list the samples in the tray protocol for each type of analytical software.

All sample tray lists which indicate each samples position in the tray are routinely stored and backed up to discs for permanent record. The label/name which identifies each sample tray list is recorded on the daily log forms.

TABLE 10.1

QUALITY CONTROL SAMPLES
METHOD SPECIFIC FREQUENCY OF DIGESTION AND ANALYSIS

METHOD	STANDARDS	QC1	QC2	STANDARD ADDITIONS	REPEAT SAMPLES	STANDARD CHECK
ION CHROMATOGRAPH						
SO4	every 20 analyses	every 20 analyses	every 20 analyses	every 20 analyses	every 10 analyses	N/A
SPECTROPHOTOMETRIC						
COLOR	every 30 analyses every 15 analyses	every 30 analyses every 15 analyses	every 30 analyses every 15 analyses	N/A every 15 analyses	every 20 analyses every 15 analyses	N/A
ATOMIC ABSORPTION						
CA, MG, NA, K TDSSR	every 15 samples every 10 samples	every 30 samples every 10 samples	every 30 samples every 10 samples	every 10 samples every 15 samples	every 10 samples every 15 samples	N/A N/A
TRACE METAL, DIGESTION	every 25 digestions	every 25 digestions	every 25 digestions	every 15 digestions		N/A
TRACE METAL ANALYSIS: AG, BA, CD, CR, CU, MN, NI, PB, ZN, AS, SE	every 15 samples every 35 digestions	every 12 samples every 35 digestions	every 15 samples every 35 digestions	every 15 samples every 15 digestions	every 10 samples	N/A
AS - SE DIGESTION	every 15 samples	every 15 samples	N/A	every 15 samples	every 20 samples	N/A
HG						

TABLE 10.1

QUALITY CONTROL SAMPLES

METHOD SPECIFIC FREQUENCY OF DIGESTION AND ANALYSIS

METHOD		STANDARDS		QC1		QC2		STANDARD ADDITIONS	REPEAT SAMPLES	STANDARD CHECK/GAIN
CONTINUOUS FLOW										
NOX, NO2, NH4		every 30 analyses		every 100 analyses		every 100 analyses		every 30 analyses	every 30 analyses	1-2 every maketray
ALCO3, CL		every 30 analyses		every 100 analyses		every 100 analyses		every 30 analyses	every 30 analyses	N/A
SiO2		every 30 analyses		every 60 analyses		every 60 analyses		every 30 analyses	every 20 analyses	N/A
TKN, TDKN DIGESTION		every rack		every rack, alternate w/QC2		every rack, alternate w/QC1		1 every rack	1 every rack	1 or 2 every rack
TKN		every 15 analyses		every 60 analyses		alternate w/QC1		every 60 analyses	every 20 analyses	1 or 2 every rack
TDKN		every 15 analyses		every 60 analyses		alternate w/QC1		every 60 analyses	every 20 analyses	1 or 2 every rack
TP04, TDPO4 DIGESTION		every 4 racks		every 2 racks		every 2 racks		2 per rack	every 30 analyses	N/A
TP04		every 30 analyses		every 80 analyses		every 80 analyses		every 20 analyses	every 30 analyses	N/A
TDPO4		every 30 analyses		every 80 analyses		every 80 analyses		every 20 analyses	every 30 analyses	
OP04		every 30 analyses		every 80 analyses		every 80 analyses		every 20 analyses	every 30 analyses	
TOTFE DIGESTION		every 50 digestions		every 50 digestions		every 50 digestions		every 20 digestions	every 20 analyses	N/A
TOTFE		every 30 analyses		every 80 analyses		every 80 analyses		every 20 analyses	every 20 analyses	
TDSE		every 30 analyses		every 60 analyses		every 60 analyses		every 20 analyses	every 20 analyses	N/A
PHYSICAL PARAMETERS										
LAB CONDUCTIVITY		every 30 samples		every 30 samples		every 30 samples		N/A	every 20 samples	N/A
LAB pH		every 30 samples		every 20 samples		every 20 samples		N/A	every 20 samples	N/A
TURBIDITY		every 30 samples		every 20 samples		every 20 samples		N/A	every 20 samples	N/A
SOLIDS: TSS, VSS, TDSSD		N/A		twice weekly		twice weekly		N/A	N/A	N/A

NOTES: TKN, TDKN 1 RACK = 40 SAMPLES
 TP04, TDPO4 1 RACK = 49 SAMPLES
 GAIN: A CONTINUING CALIBRATION STANDARD

Fig. 10-2

QUALITY CONTROL RESULTS

Parameter _____ Analyst _____ Date _____

REP NO. Upper Limits _____ Std. Cal. or Abs. _____

() QC#1 _____ result: Acceptable Value _____

() QC#2 _____ result: Acceptable Value _____

Standard Addition #1 (STAD)

% Recovery = _____

Repeat Sample

1. Std. Conc. _____

reading _____

1. _____ ()

2. Blank _____

2. _____ ()

3. Sample I.D. _____

3. _____ ()

() 4. Std. Add. I.D. _____

4. _____ ()

Standard Addition #2 (STAD)

% Recovery = _____

1. Std. Conc. _____

reading _____

5. _____ ()

2. Blank _____

6. _____ ()

3. Sample I.D. _____

7. _____ ()

() 4. Std. Add. I.D. _____

MEAN = _____

Standard Addition #3 (STAD)

% Recovery = _____

STANDARD DEVIATION = _____

1. Std. Conc. _____

reading _____

C.V. (% RSD) = _____

2. Blank _____

3. Sample I.D. _____

() 4. Std. Add. I.D. _____

$$C.V. = \frac{STD. DEV.}{MEAN} \times 100$$

$$\% \text{ recovery} = \frac{\text{Std. Add.} - \text{Sample}}{\text{Std. Cond. Blank}} \times 100$$

SAMPLES ANALYZED:

CHECK STANDARD

GAIN readings:

1. _____ ()
2. _____ ()

1. _____
2. _____
3. _____
4. _____

ANALYST: _____ **DATE** _____
PARAMETER: _____

STANDARDS:

Known Value	Instrument Reading
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

REP NO. QUALITY CONTROL SAMPLES:

() QC1 True Value	QC2 True Value
_____	_____
() _____	() _____
() _____	() _____
() _____	() _____
() _____	() _____
() _____	() _____
() _____	() _____
() _____	() _____

REPEAT SAMPLE READINGS:

() _____	() _____	() _____	() _____
() _____	() _____	() _____	() _____
() _____	() _____	() _____	() _____

SAMPLES ANALYZED: _____

ATOMIC ABSORPTION ANALYSIS LOG

Parameter _____ Number of Samples _____ Date _____

High Standard _____ Operator _____

Detection Limit _____ Method file name _____ Flame Furnace (circle 1) _____

CALIBRATION INFORMATION

CONCENTRATION

ABSORBANCE

S1	_____	_____
S2	_____	_____
S3	_____	_____
S4	_____	_____
S5	_____	_____

FILE NAMES

ID/WT filename _____

Data filename _____

Name of file transferred to
the LIMS _____

Samples _____

Comments/Problems _____

QUALITY CONTROL

FURNACE PARAMETERS

QC1 _____ QC2 _____
Accepted Values: _____

Repeat: X = _____

Std. Dev. = _____

Coef. Var. = _____

Std. Add. % Recovery:

1. _____

2. _____

3. _____

4. _____

Step	1	2	3	4	5	6
Temp °C						
Ramp (s)						
Hold (s)						
Read						
Rec.						
Baseline						
Int. Flow ml/min	10-12					

Graphite Tube: _____

Sample Volume: _____

Modifier Vol. _____

Replicates _____

Purge Gas _____

FLAME PARAMETERS

_____ : _____ (gas)

Burner _____

Modifier _____

Fig. 10-5

FIA SAMPLE LOG FORM

Technician: _____ Date: _____

Output File Name: _____ Disk Number: _____

Parameter: _____ Gain: _____

Parameter: _____ Gain: _____

Parameter: _____ Gain: _____

Parameter: _____ Gain: _____

Sample Numbers (including REWORKS):

Comments: _____

CALIBRATION:

CHANNEL 1: _____

CHANNEL 2: _____

CHANNEL 3: _____

STANDARD
CONCENTRATION

INSTRUMENT
READING

STANDARD
CONCENTRATION

INSTRUMENT
READING

STANDARD
CONCENTRATION

INSTRUMENT
READING

 .10-13 _____

QUALITY CONTR

QC1: _____

QC2: _____

C.V.: _____

STAD: _____

GAIN: _____

Fig. 10-6

RAPID FLOW ANALYZER LOG

Technician _____ Date _____

Parameter _____ Std. Cal _____
High or Low (Circle One)

C F Method Number _____ Instrument# _____

Tray Protocol File Name

Sample Numbers

Comments: _____

CALIBRATION:

CHANNEL 1: _____

CHANNEL 2: _____

QUALITY CONTROL:

QC1: _____

QC2: _____

C.V.: _____

STAD: _____

GAIN: _____

11.0 Performance and Systems Audits

The systems audit consist of the evaluation of all the various components of the sampling and measurement systems to determine their proper selection and use. A systems audit will be conducted at the beginning of each project to determine that the goals of the project can be met. This audit will include an evaluation of all equipment to be used (field and laboratory) and the quality control procedures to be performed. It is the responsibility of the project manager to request a systems audit prior to the start of a project. It is the responsibility of the field and laboratory quality assurance coordinators to perform the audit. The checklist used to perform a systems audit is shown in figure 11-1.

System audits may be conducted at any time by the Department of Environmental Regulation.

Performance audits are conducted to determine the accuracy of the measurement systems. The performance audits the laboratory conducts or participates in are as follows:

- Internal: Trace metals, nutrients, general I and II. These are not scheduled but are conducted by the Laboratory Quality Assurance Officer if problems are suspected. This audit may consist of any or all of the following: resubmission of previously analyzed samples under a different LIMS number; preparation of additional quality control samples; and submission of spike samples, all of which are blind to the analysts. These measures may be taken for one suspect parameter or for the entire laboratory.
- External: United States Environmental Protection Agency
Annually through HRS

United States Geological Survey, Denver
Semi-annually

United States Geological Survey, Ocala
Quarterly or as received (frequency has varied in the past)

South Florida Water Management District

SYSTEMS AUDIT CHECKLIST

Project Name: _____ Project No.: _____

Project Manager: _____ Date: _____

Project Code (field and lab use): _____

Field Auditor: _____ Lab Auditor: _____

Signature: _____ Signature: _____

Planning and Preparation:

- | | <u>Yes</u> | <u>No</u> |
|---|------------|-----------|
| 1. Was QA Project Plan prepared for this project? | — | — |
| 2. Was briefing held with project participants, both field and lab? Date: _____ | — | — |
| 3. Were additional instructions given to participants (i.e., changes in project plan)? | — | — |
| 4. Was there a written list of sampling locations and descriptions? | — | — |
| 5. Was there a map of sampling locations available to field personnel? | — | — |
| 6. Was sampling scheduled with field technician supervisor in advance (minimum one week)? | — | — |
| 7. Were analyses scheduled with laboratory in advance (minimum one week)? | — | — |

Comments: _____

Systems Audit Checklist
page two

General Sampling Procedures:

- | | <u>Yes</u> | <u>No</u> |
|---|------------|-----------|
| 1. Were sampling locations properly selected? | — | — |
| 2. Was sampling equipment protected from possible contamination prior to sample collection? | — | — |
| 3. If equipment was cleaned in the field, were proper procedures used? | — | — |
| 4. What field instruments were used? _____

_____ | | |
| 5. Were calibration procedures documented in the field notes? | — | — |
| 6. Were samples chemically preserved at time of collection? | — | — |
| 7. Were samples iced at time of collection? | — | — |

Comments: _____

Surface Water Sampling:

- | | <u>Yes</u> | <u>No</u> |
|--|------------|-----------|
| 1. What procedures were used to collect the surface water samples? _____

_____ | | |
| 2. Was a Niskin bottle used for sample collection? | — | — |
| 3. Was sample collected in polyethylene bucket? | — | — |
| 4. Did samplers wade in stream during sample collection? | — | — |

Systems Audit Checklist
Page three

Comments: _____

Well Sampling:

- | | <u>Yes</u> | <u>No</u> |
|---|------------|-----------|
| 1. Was depth of well determined? | — | — |
| 2. Was depth to water determined? | — | — |
| 3. Was measuring tape properly decontaminated between wells? | — | — |
| 4. Were the above depths to water converted to water level elevations common to all wells? | — | — |
| 5. How was the volume of water originally present in each well determined? _____

_____ | | |
| 6. Was the volume determined correctly? | — | — |
| 7. How was completeness of purging determined?
Volume _____
Measure _____
Time _____
Flow rate _____
SCond./pH/T _____ | | |
| 8. Was a sufficient volume purged? | — | — |
| 9. Was the well over-purged? | — | — |
| 10. Was the disposal of purge water handled properly? | — | — |
| 11. Was a dedicated (in-place) pump used?
If no: Describe method of purging: _____

_____ | — | — |

Systems Audit Checklist
Page four

- | | <u>Yes</u> | <u>No</u> |
|--|------------|-----------|
| 12. How were the samples collected? | | |
| Bailer? | | |
| Pump? | | |
| Other? Describe: _____ | | |
| _____ | | |
| _____ | | |
| 13. Construction material of bailer? _____ | | |
| 14. If a pump was used, describe how it was cleaned
before and/or between wells. _____ | | |
| _____ | | |
| _____ | | |
| 15. Were the samples properly transferred from bailer
to sample bottles (i.e., was the purgeable
sample agitated, etc.)? | | |
| 16. Was the rope or line allowed to touch the ground? | | |
| 17. Was a teflon rope used? | | |
| If no, what kind was used? _____ | | |
| Was it discarded after use at each well? | | |

Comments: _____

Sediment Sampling:

- | | <u>Yes</u> | <u>No</u> |
|--|------------|-----------|
| 1. What procedures were used to collect the samples? | | |
| _____ | | |
| _____ | | |
| _____ | | |
| 2. Were the samples well mixed prior to placing the
sample in the sample container? | | |
| 3. Were samples composited? | | |

Systems Audit Checklist
Page five

Comments: _____

Other Sampling:

- 1. What other types of samples were collected during this investigation? _____

- 2. What procedures were used for the collection of these samples? _____

Comments: _____

Field Quality Control

	Yes	No
1. Were QC samples specified in the QA Project Plan?	___	___
2. Were the QC samples collected in accordance with the QA Project Plan?	___	___
3. Did sampling personnel utilize any trip blanks?	___	___

Systems Audit Checklist
Page six

	<u>Yes</u>	<u>No</u>
4. Did sampling personnel utilize any preservative blanks?	—	—
5. Were any equipment blanks collected?	—	—
6. Were any duplicate samples collected?	—	—
7. Were any spiked samples utilized?	—	—
8. Check method used to collect split sample — Filled one large container and then transferred portions — Sequentially filled bottles	—	—
9. Were chain of custody records completed for all samples?	—	—
10. Were all samples identified with appropriate tags?	—	—
11. Were sample I.D. tags filled out properly?	—	—
12. Did information on sample I.D. tags and Chemistry Field Data Log match?	—	—
13. Were samples kept in a secure place after collection?	—	—
14. Was Chemistry Field Data Log signed by sampling personnel?	—	—
15. Were amendments to the project plan documented (on the project plan itself, in a project logbook, elsewhere)?	—	—

Comments: _____

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General Laboratory Procedures:

	<u>Yes</u>	<u>No</u>
1. Have unique sequential laboratory numbers been assigned to each sample?	—	—
2. Has the data from the Chemistry Field Data Log been input to the computer correctly?	—	—
3. Have samples been stored in an appropriate secure area?	—	—
4. Has sample custody been maintained by the laboratory?	—	—
5. Has the proper bar code label been attached to each sample I.D. tag?	—	—
6. Were the samples aliquoted properly?	—	—

Comments: _____

Analytical Methods:

	<u>Yes</u>	<u>No</u>
1. Have approved analytical methods or procedures been followed?	—	—
2. Does the project plan include copies of any non-standard methods with appropriate quality assurance results for validation of the method?	—	—
3. Does use of the analytical methods specified result in data of adequate detection limit, accuracy, and precision to meet the requirements of the project?	—	—

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Comments: _____

Laboratory Quality Control:

	<u>Yes</u>	<u>No</u>
1. Have approved sample holding times been observed?	—	—
2. Have replicate analyses been performed on at least one sample?	—	—
3. Have spike analyses been performed on at least one sample?	—	—
4. Have the quality control reporting forms been properly filled out?	—	—
5. Are the field QC samples "blind" to the lab technicians?	—	—
6. Are current instrument calibration curves used for all methods?	—	—
7. Did the spiking procedures follow acceptable protocols for quantity and concentration?	—	—
8. Are quality control charts used to track QC precision and accuracy?	—	—
9. Are QC charts kept up to date?	—	—
10. Is the precision of the data presented within acceptable limits?	—	—
11. Is the accuracy of the data presented within acceptable limits?	—	—
12. Are recent (one year or less) performance audit results available?	—	—

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13. Has the laboratory followed the preventive maintenance procedures outlined in the QA plan? Yes No

14. Is the completeness of the data acceptable? ____

Comments: _____

Data Validation and Reporting:

1. Were all the steps in the data validation procedure outlined in the QA plan followed? Yes No

2. Was the data reported in the proper format with the proper units? ____

3. Was the laboratory I.D. number included on each page of the data? ____

Comments: _____

12.0 Preventive Maintenance

Preventive maintenance is a necessary part of a successful quality assurance program. Time must be allocated to clean and maintain all equipment used in a project. Equipment which is not operating properly gives unreliable results.

Maintenance contracts are carried on major pieces of equipment which are no longer under warranty and cannot be easily repaired by SFWMD personnel.

12.1 Field Equipment Maintenance

Procedures are established for the routine maintenance of the field equipment. These activities are documented in bound notebooks that are assigned to the following instrumentation:

1. Hydrolab 4000 and Surveyor II - every three months the dissolved oxygen probe membrane and electrolyte are changed, the conductivity probe sensors are sanded with emery cloth, and the pH and reference electrodes are cleaned with methanol. The pH reference probe is refilled with KCl (3M) on a monthly basis.
2. Hydrolab 4000 and Surveyor II - the 2.7V battery is replaced annually.
3. Hydrolab 5100A Datalogger - the 4 "C" batteries are replaced every three months.
4. Automatic Water Samplers - the units are checked biweekly for correct operation. The intake lines are flushed with 20% HCl annually.
5. Automatic Precipitation Collector - the unit is checked every two weeks for correct operation and the lines and buckets are flushed with deionized water. Every six weeks the 12V battery and LP gas tank are replaced.

12.2 Laboratory Equipment Maintenance

Procedures are established for the routine maintenance of the laboratory instruments. The frequency of primary standard calibration is given in Section 7.2.

Maintenance is documented using checklists which are dated and by making notations on the forms shown on pages 10-8 through 10-11.

1. Analytical balance - serviced every six months by Weight-Check of Jupiter, FL. Class S weights are used to check the calibration of the balance every month. Soft bristle brushes are used to clean the weighing compartment after each use.
2. Atomic absorption spectrophotometers - maintenance contracts are maintained with Perkin-Elmer. Flame nebulizers and burner heads are cleaned ultrasonically in soapy water and dipped in dilute HNO₃ solution bi-weekly; graphite furnace windows, tubes, and platforms are cleaned with isopropyl alcohol on a daily basis and a complete furnace decontamination procedure recommended by Perkin-Elmer is conducted monthly. Hydride instrumentation components are cleaned in soapy water and/or acid solution on a monthly basis. A consumable parts inventory is maintained.
3. Ion Chromatograph - is under maintenance with Dionex Corporation; the column is cleaned only if contamination is suspected; decontamination procedures are provided by the manufacturer. A consumable spare parts inventory which includes spare columns is maintained.
4. Visible Spectrophotometer - is cleaned before and after each days use. A consumable parts inventory is maintained and service is performed when needed by the Milton Roy Company Service Division.
5. Turbidimeter - cells are rinsed with deionized water after each use and cleaned with hot Liquinox™ solution on a monthly basis. A supply of replacement lamps and additional sample cells is maintained.
6. Conductivity Meter - electrode is thoroughly rinsed with deionized water after each use. Manufacturers cleaning procedure is followed if problems are suspected. A supply of replacement electrodes is maintained. Between use the electrode is stored in deionized water.
7. pH Meter - electrode is thoroughly rinsed with deionized water after each use and stored in pH 7 buffer between use. Manufacturers cleaning procedure is followed if problems are suspected. A supply of replacement electrodes is maintained.
8. Flow Injection Analyzer - instrument is rinsed with deionized water after each use. Cleaning with dilute acid and alkali solutions is performed at regular intervals. A spare parts inventory is maintained. The SFWMD electronics shop provides limited repair service. Any repair not done internally is done by the manufacturer, Lachat Chemicals, Inc., with loaners provided within 48 hours (usually 24 hours).

9. Rapid Flow Analyzer - instrument is rinsed with deionized water after each use. Cleaning with dilute acid and alkali solutions is performed at regular intervals. A spare parts inventory is maintained. Maintenance and service is provided by Alpkem Corporation.
10. Laboratory Water System - the reverse osmosis and deionizing systems are maintained by the lab staff for routine filter changes. A contract is maintained with Water Equipment Technology, Inc., West Palm Beach for the changing of the RO and deionization cartridges. An in-line resistivity meter is monitored daily to determine the quality of water being produced; RO and DI particulate filters are changed every 2-3 weeks or more frequently in order to maintain water of good quality and sufficient quantity.
11. Laboratory Information Management System - a maintenance contract is maintained with Perkin-Elmer for the LIMS computer and associated peripheral devices. P-E provides service within 24 hours on the CPU and sufficient terminals and printers are available in the lab to prevent downtime based on peripheral failure. A total disc backup to tape is performed on a weekly basis to eliminate any downtime of the FIA based on computer problems.. Sufficient IBM PC's are available within the SFWMD.

The SFWMD has a number of pH meters, conductivity meters, and turbidimeters available if any of these instruments breakdown in the laboratory. Breakdown of major instrumentation is handled in the following manner: loaner modules for the Flow Injection Analyzer and Rapid Flow Analyzer are available within 24-48 hours and are used until repairs can be completed; two complete rapid flow analyzers are used in the laboratory, if necessary, analyses can be prioritized and assigned to the remaining RFA; atomic absorption instrumentation is serviced from the Perkin-Elmer Fort Lauderdale office and response is within 24-48 hours.

Laboratory instrument maintenance performed by SFWMD personnel is recorded in the instrument logbook. Routinely scheduled cleaning procedures are tracked by using check lists. Copies of service/maintenance reports detailing the type of service provided by contracted organizations are either kept in files or in the respective instrument logbook.

13.0 Specific Routine Procedures Assess Data Precision, Accuracy, and Completeness

The precision and accuracy of each parameter are measured on a daily basis. Each analytical set includes QC check samples as described in Section 10.2. The field spikes, blanks and replicates are analyzed as routine samples and are not identified to the analyst prior to the analysis.

Accuracy can be defined as the agreement between the actual obtained result and the expected result. Two types of QC check samples, QC1 and QC2 having a known or "true" value, and standard additions also with an expected result, are used to test for the accuracy of a measurement system. Accuracy may be quantified by comparing results obtained for QC1 and QC2 to their true values and calculating a percent recovery using the following equation:

$$\text{Percent Recovery} = \%R = \frac{\text{obtained value} \times 100}{\text{"true" value}}$$

Accuracy may be further expressed using the standard addition samples. The values obtained for standard additions are used to calculate percent recovery using the following equation:

$$\text{Percent Recovery} = \%R = \frac{(\text{sample \& spike}) - \text{sample}}{\text{spike added}} \times 100$$

The percent recovery values for standard addition samples may also be used as an indication of bias.

Precision can be defined as the agreement or closeness of two or more results and is an indication that the measurement system is operating consistently within a given time period. Because the SFWMD laboratory is highly automated and can analyze large numbers of samples in a short period of time, one sample is chosen as the repeat sample for each parameter and is analyzed several times over the course of the run. For example, a total phosphate repeat sample analyzed four times on the RFA operating at a rate of 72 analyses per hour will be analyzed once every 19 minutes in a 90 sample run. Prior to the beginning of the run, the selected sample is tested to assure that it does give a value at least 10 times the detection limit. Since each replicate sample is analyzed more than two times during an analytical run, it is appropriate to use the percent relative standard deviation, also expressed as the coefficient of variation, as the basis of acceptability of an analytical run. The control limits for precision are +/-2 standard deviations of the historical percent relative standard deviation.

$$\text{Mean} = \bar{X} = \frac{\sum X_i}{n}$$

$$\text{Standard deviation} = s = \sqrt{\frac{\sum X_i^2 - (\sum X_i)^2/n}{n-1}}$$

where \bar{X} = mean and n = number of values.

$$\text{Percent relative standard deviation} \quad \%RSD = \frac{s}{\bar{X}} \times 100$$

On a daily basis, the results obtained for each of the quality control check samples being used to assess accuracy and precision are compared to acceptable limits that are based on highly specific historical data. Section 14.1 describes how acceptable limits are established.

Completeness is determined by comparing the number of quality control results which fall within the control limits by the total number of results. The goal for completeness is 100% but a realistic expectation is that at least 95% of the results of quality control checks will fall within the control limits established on historical data.

$$\text{Completeness} = 100 \times \frac{\text{number of acceptable QC results}}{\text{total number of QC results}}$$

References: see p.4-4.

14.0 Corrective Action

Corrective Action begins with the analyst responsible for each analysis. Table 14.1 the quality control activities (in the order they must be performed) and their corresponding acceptance criteria which must be met before proceeding to the next step. The instrument response graphs are instrument-parameter specific and are established as described in Section

The means by which acceptable limits are established is described in Section 14.1. The supervisor is contacted when the problem cannot be easily corrected by simple measures. If a problem cannot be corrected at any point in the quality control activity scheme, the analysis is discontinued, and the analyst consults with his/her supervisor and must reanalyze any suspect samples once the problem is resolved. Troubleshooting activities are documented in detail in one of the following: analysis logbooks, digestion logbooks, or instrument maintenance logs depending on the nature of the problem and how it was solved. The supervisor will report the problem to the Lab Quality Assurance Officer who has the responsibility for determining if the solution is acceptable and if not, what further steps should be taken.

The laboratory and field personnel will subscribe to any corrective action deemed necessary by the DER or DHRS QA officers.

Corrective actions may be initiated as a result of any QA activity, including:

1. Performance Audits
2. System Audits
3. Laboratory/interfield comparison studies
4. QA project audits conducted by DER

14.1 Acceptable Limits

The acceptable limits used to determine if an analysis is in control are highly specific and established using historical data. Quality control results for each parameter and each type of QC sample (QC1, QC2, repeats, and standard additions) are compiled and graphed on a quarterly basis. Examples of these graphs are provided in Figures 15-1 and 15-2. The average value, standard deviation, and population are taken from each graph and stored in files on the Laboratory QA Officer's database. A separate file is maintained for each type of QC sample and each parameter. For example, the quarterly statistical evaluation of all standard addition percent recovery values for potassium are stored in one file labeled KSAD.DAT. The quarterly statistical evaluation of all QC1 and QC2 values for potassium are stored in a file labeled KQC.DAT.

An example of this type of file is shown in Figure 14-1. These statistics are used to calculate a historical relative standard deviation (H%RSD) using the following equation:

Historical % RSD =

$$\frac{\sum_{i=1}^{\infty} \frac{S_i}{X_i} \times 100 \times N_i}{\sum_{i=1}^{\infty} N_i}$$

where

S_i = standard deviation

X_i = mean

N_i = population of values

Once the H%RSD is calculated a "true value" can be entered and the range of acceptable values are determined. The acceptable limit is defined as the true value ± 2 H%RSD. Thus as the true value changes, the acceptable limits based on historical data can be determined. The true value for standard additions is defined as the ideal, 100% recovery.

The acceptable limits established by the procedure described above are listed in a tabulated format as shown in Fig. 14-2, and copies given to all laboratory personnel. These lists are used by the analysts in place of control charts.

The acceptable limits tables are amended when the true value of any QC sample changes and are updated to reflect most recent QA reports on a bi-annual basis. The use of tables as opposed to control charts are beneficial as they are easier for each analyst to use and they are more accessible to the analyst since a copy of the tables is given to each analyst.

Since the "true value" cannot be established for randomly chosen repeat samples, the acceptable limits for repeat sample coefficients of variation have been rounded to values of ≤ 5.0 or ≤ 10.0 , depending on the method and instrumentation.

Figure 14-1

QUARTERLY STATISTICAL RESULTS FOR POTASSIUM
SAMPLES QC1 AND QC2

KQC.DAT

>1 MEAN	STANDARD DEVIATION	POPULATION
3.90	8.0E-02	2
3.77	0.27	9
3.91	0.1	12
3.84	0.19	13
3.94	9.0E-02	19
3.96	0.142	23
3.97	0.139	19
3.98	0.165	28
6.49	0.63	2
5.85	0.24	9
5.95	0.16	12
5.87	0.21	14
6.01	0.13	19
6.03	0.154	23
79.1	3.77	18
78.7	3.64	28
3.92	8.29999E-02	21
76.0	3.86	23
3.94	7.5E-02	14
152.8	6.79	19
3.95	9.3E-02	21
153.5	6.67	24
3.97	8.0E-02	23
110.2	6.27	23
3.98	5.7E-02	16
114.1	3.86	16

TABLE 14.1 CORRECTIVE ACTION GUIDELINES

QUALITY ASSURANCE ACTIVITY	ACCEPTANCE CRITERIA, PROCEED TO NEXT ACTIVITY IF CRITERIA ARE MET	POSSIBLE CORRECTIVE ACTION WHEN CRITERIA ARE NOT MET
1. Initial Instrument Calibration and Blank Analysis	Instrument Response Graphs	<ul style="list-style-type: none"> - prepare standards again - check instrument set up, reagents, and maintenance logs - check condition of consumable parts (i.e. pump tubes, lamps, graphite tubes, IC columns) - review logbooks for record of similar response in the past and corrective measures taken - review logbooks used to document digestion of standards and samples, if applicable
2. Analysis of Quality Control Samples 1 and 2	Acceptable Limits	<ul style="list-style-type: none"> - recalibrate and analyze a second aliquot
3. Analyze a routine sample as a Standard Addition	Acceptable Limits	<ul style="list-style-type: none"> - prepare standard addition again and analyze - check means of preparation, mixing, etc.
4. Recalibration (at each parameter specified interval)	Instrument Response Graphs	<ul style="list-style-type: none"> - check for any changes in instrument response - baseline drift, loss of lamp energy, etc... - see Initial Calibration and Blank Analysis
5. Analyze a repeat sample (at each parameter specified interval)	Coefficient of variation between repeat readings must be less than the maximum established in Acceptable Limits	<ul style="list-style-type: none"> - check for instrument drift, loss of lamp energy, depletion of reagents, etc... - ensure sample is uniformly mixed, pour a second aliquot, and analyze again
6. Analyze Check Standards (applicable to TKN, TDKN and NOX analyses)	Acceptable Limits	<ul style="list-style-type: none"> - review logbooks regarding preparation of Check Standards - analyze again

Figure 14-2. TABULATION OF ACCEPTABLE LIMITS FOR LABORATORY QC CHECK SAMPLES

PARAMETER - QC		HISTORICAL % RSD	TRUE VALUE	ACCEPTABLE LIMITS T.V. \pm 2 RSD
ALCO3	QC1	4.91	50	45.1-54.9
ALCO3	QC2	4.91	211	190.3-231.7
ALCO3	STAD	9.25	100	81.5-118.4
ALCO3	RPT			C.V. < 5.0
CL	QC1	2.83	62.5	58.9-66.0
CL	QC2	2.83	362	341.5-382.5
CL	STAD	6.62	100	86.8-113.2
CL	RPT			C.V. < 5.0
NH4	QC1	8.04	0.30	0.27-0.33
NH4	QC2	8.04	1.25	1.12-1.37
NH4	STAD	6.34	100	86.7-113.3
NH4	RPT			C.V. < 10.0
NO2	STAD	4.16	100	91.7-108.3
NO2	RPT			C.V. < 10.0
NOX	QC1	5.06	0.06	0.054-0.066
NOX	QC2	5.06	0.36	0.324-0.396
NOX	STAD	5.43	100	89.1-110.9
NOX	CHK1	4.77	0.100	0.090-0.110
NOX	CHK2	4.77	0.500	0.452-0.548
NOX	RPT			C.V. < 5.0
OPO4	QC1	4.56	0.075	0.067-0.083
OPO4	QC2	4.56	0.875	0.795-0.954
OPO4	STAD	7.94	100	84.1-115.9
OPO4	RPT			C.V. < 10.0

15.0 Quality Assurance Reports to Management

The laboratory and field quality assurance coordinators are responsible for compiling quarterly quality assurance reports to management. These reports will include the identification of any significant quality assurance problems and their solution, the outcome of any corrective actions required, the results of any performance audits conducted in the time period, the results of any systems audits, and the table and graphs associated with the laboratory quality assurance program.

Table 15-1 is an example of a table compiling the results of the quality control samples for a quarter which gives an overall summary. Figures 15-1 and 15-2 are examples of the graphs produced by the computer for the spike and "known" samples.

Project managers are responsible for compiling the project specific quality assurance reports.

A final quality assurance report will be generated for each DER project. This final report will be a summary of the quarterly reports or for short projects the only report. Copies of all quarterly and final quality assurance reports will be forwarded to the appropriate DER office by the project manager.

Figure 15-1 Spike QC Graph

K STANDARD ADDITIONS

AVERAGE VALUE = 104.343

STANDARD DEVIATION = 2.75294

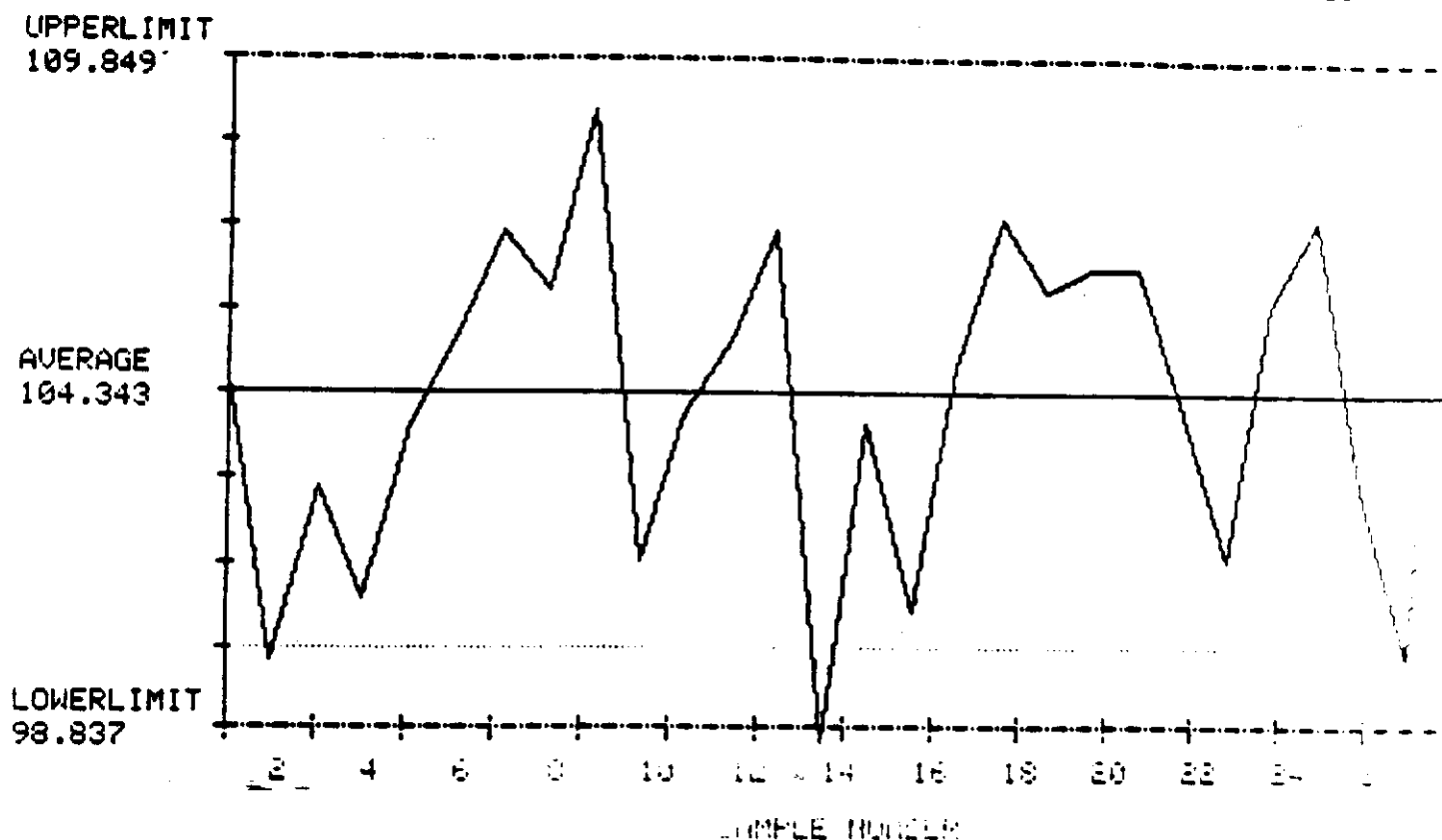
95% CONFIDENCE LIMIT = ± 5.50589

TEST: K

MINIMUM VALUE = 98.837

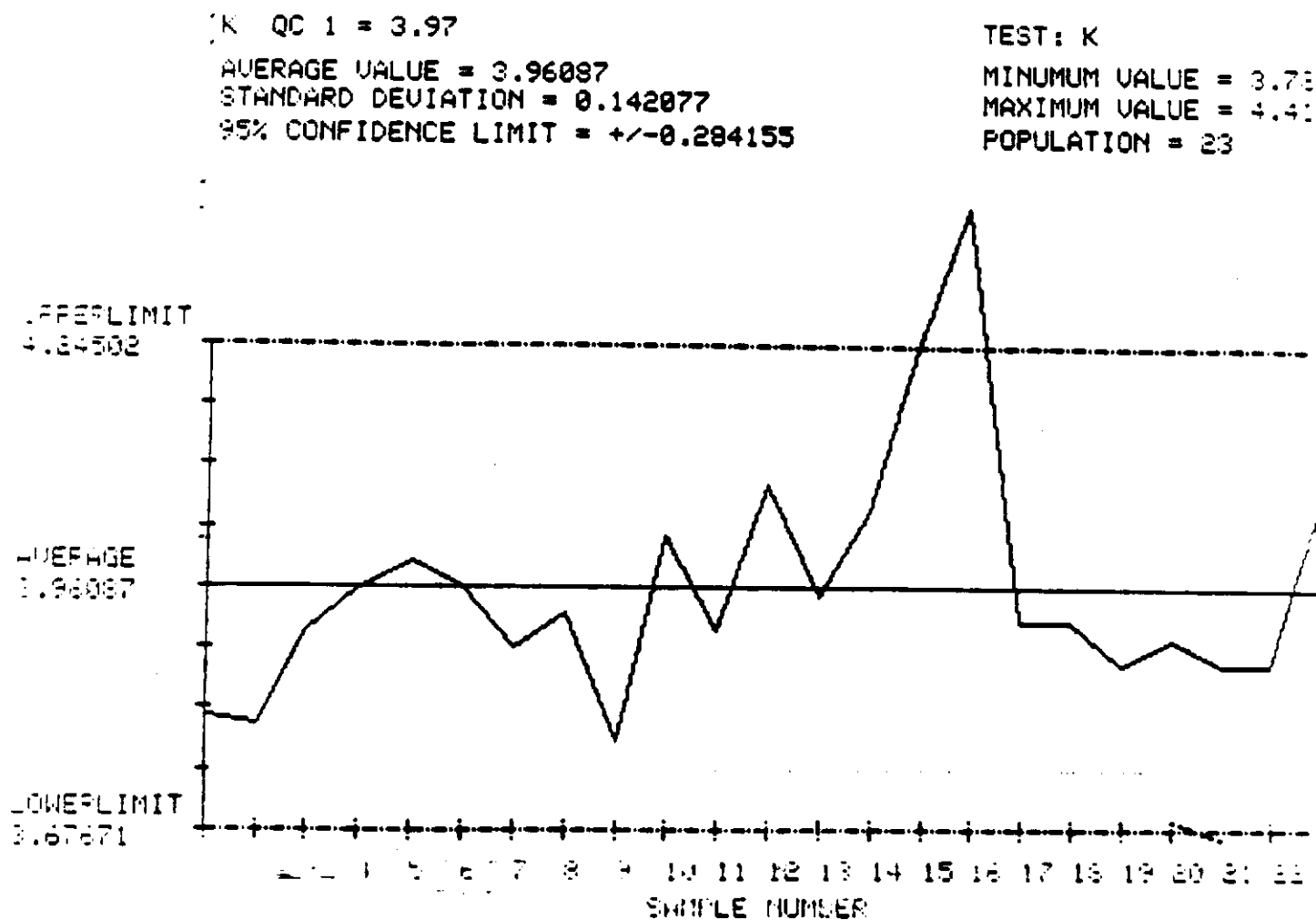
MAXIMUM VALUE = 109.849

POPULATION = 25



ANOTHER FILE (Y/N) : _

Figure 15-2 "Known" QC Graph



QUALITY ASSURANCE SUMMARY

Parameter	Quality Control Sample 1				Quality Control Sample 2				Standard Additions			Repeat Sample	
	Range	Mean	"True" Value	n	Range	Mean	"True" Value	n	Range	Mean	n	Coef of Variance	n
ALCO ₃	229.6-245.0	235.4	225	13	45.3-57.0	51.3	50	9	56.0-110.0	94.6	10	5.09	13
Cl	209.0-215.0	212.2	212.5	16	60.4-67.4	62.9	62.5	17	61.6-112.2	99.6	14	1.71	15
NH ₄	127-2	1525	0.15	10	1.07-1.24	1.18	1.25	11	92.3-113.0	101.2	23	88.70	14
NO ₂									86.0-109.5	100.6	15		
NO ₃	0.059-0.077	0.063	0.06	14	0.345-0.377	0.359	0.36	14	92.7-111.7	103.7	20	9.42	12
OPO ₄	0.04-0.055	0.048	0.05	17	0.82-0.889	0.860	0.875	7	89.0-111.0	100.1	27	26.00	26
SiO ₂	6.13-9.57	7.83	9.0	14	72.3-78.1	74.96	62.5	10	92.7-111.2	102.3	10	4.90	12
SO ₄	15.8-19.5	17.9	25.0	15	72.1-78.8	76.0	75.0	16	60.6-111.3	94.5	14	10.80	31
TKN	2.03-2.55	2.23	2.25	11	4.14-4.9	4.35	4.5	10	91.4-126.1	101.0	10	5.71	68
TOTFE	0.254-0.290	0.265	0.25	9	0.677-0.769	0.736	0.75	9	83.0-124.0	103.9	13	10.20	20
TDSFE	0.201-0.8	0.53	0.25	3	0.164-0.712	0.402	0.75	3	68.5-111.8	99.0	8	19.10	5
TPO ₄	0.034-0.057	0.0456	0.05	27	0.8-0.911	0.851	0.875	17	60.0-114.5	87.6	39	9.24	60
CA	22.8-28.1	25.3	25.08	26	59.8-70.8	65.6	65.2	27	84.0-109.1	99.8	25	5.40	21
K	3.78-4.41	3.96	3.97	23	3.68-6.51	5.93	5.95	24	98.6-109.0	104.3	28	4.46	19
MG	9.18-10.9	9.86	9.97	25	31.8-35.6	34.5	34.9	25	92.4-105.8	100.7	26	3.78	19
NA	24.5-29.9	26.3	25.18	23	87.3-96.5	92.0	90.6	24	92.4-113.1	101.7	26	3.73	19
TDSSR	2.75-3.32	2.98	3.00	16	4.2-5.55	4.82	5.00	15				18.10	4
Color	46.0-52.0	50.0	50	26	247.0-255.0	250.2	250	26				4.59	37
LCOND	710.0-723.0	719.0	720	21	1930-2000	1970.5	2000	21				1.10	29
LPH	5.91-5.99	5.96	6.00	19	7.91-7.99	7.95	8.00	19				1.24	24
TURB	5.6-6.4	5.96	6.00	28	9.4-10.2	9.7	10.0	28				5.48	37
TSS	66.0-103.0	94.5	108.0	10									
TDSSD	248.0-382.0	301.4	272.0	7									
VSS	2.0-79.0	47.7	45.0	7									
TOTAS	24.6-30.1	26.3	26.7	25					90.4-112.4	99.4	15	6.20	10
TOTCD	7.17-10.2	9.04	9.1	18					36.8-101.0	27.4	13	6.06	11
TOTCO	36.9-41.5	39.2	42.6	2					95.9-98.9	97.2	2	5.96	2
TOTCR	6.78-9.82	8.08	6.8	15					37.2-117.0	88.9	8	6.12	10
TOTCU	7.67-11.5	9.24	8.9	22					50.4-136.4	96.8	13	4.77	13
TOTHG	0.87-1.24	1.09	1.49	7					87.5-118.0	100.9	10	7.12	6
TOTMN	12.0-13.3	14.0	12.9	19					90.2-130.8	101.4	11	4.59	10
TOTNI	14.4-18.2	16.7	17.1	6					102.0-124.5	113.1	4	5.66	3
TOTPB	11.2-54.3	45.9	42.7	21					68.6-124.2	90.0	9	4.60	15
TOTZN					405.1-443.0	421.5	418.0	11	82.9-119.4	103.0	11	2.48	12
TDKN	2.20-2.23	2.21	2.25	2					88.4-107.7	97.3	6	8.12	31
TDPO ₄	0.036-0.05	0.044	0.05	13					65.0-105.0	87.1	14	6.96	21

Table 15-1. Quality Assurance Summary

16.0 Resumes

These resumes represent the SFWMD personnel most likely to be involved with DER projects. The resumes of specific persons involved with each project will be included in the specific project QA Plan.

BRADLEY L. JONES
Supervising Professional-Environmental

Area of Specialization: Limnology and eutrophication.

Experience: South Florida Water Management District

1987-Present - Supervising Professional, Water Quality Division. Supervisor for Lake Research and Surface Water Quality Monitoring Section including lake water quality research, development of lake nutrient loading criteria, and surface water quality and pesticide monitoring networks.

1981 to 1987 - Environmentalist, Water Quality Division. Responsible for water quality monitoring programs and eutrophication assessments for Lake Okeechobee and other south Florida lakes.

Iowa State University, Ames, Iowa

1979-1981 - Research assistant. Assisted in the water quality monitoring of Iowa lakes.

1978 - Assistant in fisheries research.

Education: M.S. - Animal Ecology (Limnology), 1981
Iowa State University, Ames, Iowa

B.S. - Biology, 1978
Iowa State University, Ames, Iowa

Professional Affiliations: North American Lake Management Society
American Society of Limnology and Oceanography
Florida Academy of Sciences

Continuing Education: Mathematical Modeling of Lake and Reservoir Water Quality, Duke University, 1985.

LARRY V. GROSSER
Technician Supervisor
Surface Water Sampling QA Coordinator

Area of Specialization: Water sample collection, maintenance and calibration of field equipment, and supervision of the field technicians.

Experience: South Florida Water Management District

1985 - Present - Technician Supervisor, Water Quality Division. Responsible for the scheduling of division field programs, supervision of field technicians and management of inventory.

1978 - 1985 - Technician IV, Water Chemistry Division. Responsible for maintenance and calibration of field instrumentation, administration of division vehicle pool, ordering of supplies and limited supervision of field technicians.

1975 - 1978 - Technician III, Water Chemistry Division. Responsible for surface water sample collection and data retrieval.

Central and Southern Florida Flood Control District

1973 - 1975 - Technician II, Environmental Sciences Division. duties included collection of water and biological samples.

1972 - 1973 - Technician I, Environmental Sciences Division. Duties included the collection of water samples and fecal and coliform bacteria testing.

JEFFRY W. HERR
Research Hydrogeologist
Groundwater Sampling Quality Assurance Coordinator

Area of Specialization: Groundwater quality monitoring and sampling.

Experience: South Florida Water Management District

1989 - Present: Research Hydrogeologist, Water Quality Division. Responsible for the supervision of field sampling personnel, collection and interpretation of groundwater quality data. Writing technical reports on research findings.

1985 - 1989: Hydrogeologist, Water Quality Division. Responsible for the collection and interpretation of groundwater quality data. Writing technical reports on research findings.

1983 - 1985: Hydrogeologist, Groundwater Division. Responsible for the collection and interpretation of groundwater quality data. Developing methodologies and procedures for groundwater quality monitoring.

Education: B.S. - Geology, 1983
Florida Atlantic University, Boca Raton, Florida

Professional Affiliations: National Water Well Association
Florida Academy of Sciences

Continuing Education: Groundwater and Unsaturated Zone Sampling and Monitoring for the New Practicing Ground Water Professional, NWWA, 1986; DRASTIC Workshop for Evaluating Groundwater Pollution Potential Using Hydrogeologic Settings, FDER and NWWA, 1986; Organic Substances in Water, USGS, 1986; Hazardous Waste Site Sampling, EPA Region IV, 1984.

GARY J. RITTER
Supervisor, Water Quality Field Office

Area of Specialization: Watershed monitoring of agricultural non-point source runoff and evaluation of agricultural best management practices. Design of watershed monitoring systems and management of watershed monitoring programs. Personnel management and coordination.

Experience: **South Florida Water Management District**

1987 to present - Supervisor, Water Quality Field Office. Responsible for management and supervision of water quality field office including the scheduling of field sampling, ordering of supplies, routine personnel matters, program management, and program interpretation and evaluation. Administer contracts concerning nutrient and waste management modeling.

1984 to 1987 - Research Environmentalist, Water Quality Division. Responsible for management of agricultural watershed programs in the Taylor Creek/Nubbin Slough Basin and the lower Kissimmee Valley, supervision of program support personnel and management of a satellite field office. District liaison to local, state and federal agencies and landowners involved in related programs in the area.

1983 to 1984 - Environmentalist II Water Chemistry Division. Responsible for documenting impacts of agricultural BMP's on water quality for the federal RCWP project. Provide technical assistance to local, state, and federal agencies and landowners involved in related programs in the area.

1980 to 1983 - Environmentalist I, Water Chemistry Division. Responsible for water quality monitoring throughout the Taylor Creek/Nubbin Slough basin and assisting local USDA- SCS agents in developing water quality plans for agricultural BMP programs in the state supported Taylor Creek Headwaters Project.

1979 to 1980 - Laboratory Technician II, Water Chemistry Division. Responsible for the analysis of nutrients and physical parameters at a remote laboratory.

1978 to 1979 - Field Technician I, Water Chemistry Division. Responsible for the routine collection of water quality samples, servicing of field equipment and analysis of physical parameters.

University of Florida, Gainesville Florida
1976 to 1977 - Fisheries Lab Technician. Responsible for
the identification of benthic invertebrates for on-going
fisheries research.

Education: B.S. - Forest Resources and Conservation, 1977
University of Florida, Gainesville, Florida.

ERIC G. FLAIG
Research Environmentalist

Area of Specialization: Watershed monitoring system design, Hydrologic and water quality model simulation, Statistical analysis, soil chemistry, and agricultural engineering.

Experience: South Florida Water Management District

1986 to present - Research Environmentalist, Water Quality Division. Perform water quality data interpretation. Design and develop monitoring program. Administer research contracts for phosphorus transport. Conduct water quality modelling.

Environmental Science and Engineering, Inc., Gainesville, Florida

1985-1986 - Associate Scientist, Designed computer programs for hazardous waste management. Converted microcomputer code of groundwater models.

University of Florida, Gainesville, Florida

1986 Instructor, Agricultural Engineering Dept., Help develop and present video course on hydrologic and water quality simulation.

1981-1985 - Graduate Research Assistant, Designed and constructed field experimentation. Setup and conducted soil and water chemical analyses. Programmed microcomputers for data acquisition and geostatistics.

1980-1981 - Lab. Technologist, Agricultural Engineering Dept. Operated a small water quality lab. Supervised student assistants.

1976-1980 - Graduate Research Assistant, Soil Science Dept. Designed and conducted lab solute transport studies. Conducted independent greenhouse and soil redox chemistry studies. Sampled and analyzed soil and tree tissue from plots throughout the South.

Professional Organizations: American Society of Agricultural Engineers
American Society of Agronomy
American Geophysical Union
Florida Soil and Crop Science Society

Education: Ph.D. - In progress Agricultural Engineering ,
University of Florida, Gainesville, Florida

M.S. - Soil Science, 1979
University of Florida, Gainesville, Florida

B.S.F. - Forestry, 1976
Michigan Tech. University, Houghton, Mich.

Special Studies, Soil Science & Watershed Management
Colorado State University, Ft. Collins, Colo.

BOYD E. GUNSALUS

Environmentalist

Area of Specialization: Monitoring agricultural non-point source pollution. Management of watershed water quality monitoring program.

Experience: South Florida Water Management District

1987 to present - Environmentalist, Water Quality Division.

Responsible for water quality monitoring for Taylor Creek/Nubbin Slough, lower Kissimmee River and Arbuckle Creek basins. Responsible for conducting QA/QC procedures in the field, providing data summaries to project manager. Liaison with landowners, government agencies and District consultants. Monitor development of BMPs in all basins.

1986-1987 - Water Quality Research Technician, Water Quality Division. Responsible for water quality data and sample collection in the lower Kissimmee River valley and the Taylor Creek/Nubbin Slough basin.

1985-1986 - Water Quality Technician, Water Quality Division.

Responsible for data and sample collection for the Spring Hill retention/detention project.

1983-1985- Environmental Technician, Martin Power Plant, Florida Power and Light.

Responsible for monitoring 6600 ac. Cooling pond.

Education: B.S. - Environmental Technology/ Aquaculture, 1982
Florida Institute of Technology, Jensen Beach, Fl.

ELAINE T. RANKIN

Water Quality Research Technician

Area of Specialization: AutoCAD system operation, water quality sampling, and field instrumentation service.

Experience: South Florida Water Management District

1984 to Present - Water Quality Research Technician, Water Quality Division. Responsible for environmental data and sample collection within the Taylor Creek/ Nubbin Slough (TC/NS) Basin. Perform administrative duties for staff as required.

1979-1983 - Field Technician I, Water Chemistry Division.

Collected data and samples for TC/NS project. Perform secretarial duties as required. Performed lab analyses as needed.

Education: A. A. - Liberal Arts, 1976
Palm Beach Junior College, Lake Worth, Fl.
- Biology, 1958 - 1959
University of Florida, Gainesville, Fl.

MARY K. OSKING

Water Quality Research Technician

Area of Specialization: Collection of water quality samples, maintenance of in-situ water quality and hydrologic field equipment, and maintenance of water quality database. Knowledge of beef cattle and dairy operations in local area.

Experience: South Florida Water Management District

1988 to Present - Water Quality Research Technician, Water Quality Division. Responsible for environmental data and water quality sample collection in Taylor Creek/Nubbin Slough, lower Kissimmee River and Arbuckle Creek basins. Responsible for conducting chemical analysis for unfiltered SRP at field station and maintenance of associated data base.

1987 to 1988 - Water Quality Technician, Water Quality Division. Responsible for environmental data and water quality sample collection in Taylor Creek/Nubbin Slough and lower Kissimmee River basins. Responsible for conducting chemical analysis for unfiltered SRP at field station and maintenance of associated data base.

Education: 1988 to Present - Computer Programming
Indian River Junior College, Ft. Pierce, FL.

1982 to 1985 Chemistry, East Tennessee State
University, Johnson City, Tenn.

LINDA M. CRANE

Water Quality Research Technician

Area of Specialization: Collection of water quality samples, maintenance of in-situ water quality and hydrologic field equipment, and maintenance of water quality database. Knowledge of beef cattle and dairy operations in local area.

Experience: South Florida Water Management District

1989 to Present - Water Quality Research Technician, Water Quality Division. Responsible for environmental data and water quality sample collection in Taylor Creek/Nubbin Slough, lower Kissimmee River and Arbuckle Creek basins. Responsible for conducting chemical analysis for unfiltered SRP at field station and maintenance of associated data base.

1987 to 1989 - Water Quality Technician, Water Quality Division. Responsible environmental data and water quality sample collection in Taylor Creek/Nubbin Slough and lower Kissimmee River basins. Maintenance of field equipment.

Education: 1981 - Animal Science
Indian River Community College, Ft. Pierce, Fl.

1979 - Laboratory Technician
Miami Professional Institute, Miami, Fl.

1966 - 1978 Nursing Dade Junior College, Miami, Fl.

SHEILA MILLER

Water Quality Research Technician

Area of Specialization: Collection of water quality samples, maintenance of in-situ water quality and hydrologic field equipment, and maintenance of water quality database. Knowledge of beef cattle and dairy operations in local area.

Experience: South Florida Water Management District

1989 to Present - Water Quality Research Technician, Water Quality Division. Responsible for environmental data and water quality sample collection in Taylor Creek/Nubbin Slough, lower Kissimmee River and Arbuckle Creek basins. Responsible for conducting chemical analysis for unfiltered SRP at field station and maintenance of associated data base.

1988 to present - Water Quality Technician, Water Quality Division. Responsible environmental data and water quality sample collection in Taylor Creek/Nubbin Slough and lower Kissimmee River basins. Maintenance of field equipment.

1986 - 1987: Waste Water Treatment Plant Operator. Okeechobee Waste Water Treatment Plant, Okeechobee, Florida.
Florida Class "C" licenced

Education: A.S. - Marine Laboratory Technology, 1977
Cape Fear Technological Institute, Wilmington, N. C.

ISSAC T. CALLOWAY

Water Quality Research Technician

Area of Specialization: Collection of water quality samples, maintenance of in-situ water quality and hydrologic field equipment, and maintenance of water quality database. Knowledge of beef cattle and dairy operations in local area.

Experience: South Florida Water Management District

1989 to Present - Water Quality Research Technician, Water Quality Division. Responsible for environmental data and water quality sample collection in Taylor Creek/Nubbin Slough, lower Kissimmee River and Arbuckle Creek basins. Responsible for conducting chemical analysis for unfiltered SRP at field station and maintenance of associated data base.

1988 to present - Water Quality Technician, Water Quality Division. Responsible environmental data and water quality sample collection in Taylor Creek/Nubbin Slough and lower Kissimmee River basins. Maintenance of field equipment.

Education: 1962 to 1981 - Technical training, photographic chemistry equipment sales and service, AGFA-GEVAERT, Inc., Atlanta, Georgia.

ROBERT A. BONEY
Water Quality Technician

Area of Specialization: Collection of water quality samples, maintenance of in-situ water quality and hydrologic field equipment, and maintenance of water quality database. Knowledge of beef cattle and dairy operations in local area.

Experience: South Florida Water Management District

1988 to present - Water Quality Technician, Water Quality Division. Responsible environmental data and water quality sample collection in Taylor Creek/Nubbin Slough and lower Kissimmee River basins. Maintenance of field equipment.

1987 to 1988 - Equipment Operator 2, Okeechobee Field Station. Responsible for structure maintenance for the northern end of Lake Okeechobee and surrounding canals.

Education: 1987 to present - Attending Indian River Community College work toward an AA degree in agricultural marketing.

CYNTHIA M. DOUGLAS
Water Quality Technician

Area of Specialization: Collection of water quality samples, maintenance of in-situ water quality and hydrologic field equipment, and maintenance of water quality database. Knowledge of beef cattle and dairy operations in local area.

Experience: South Florida Water Management District

1989 to present - Water Quality Technician, Water Quality Division. Responsible environmental data and water quality sample collection in Taylor Creek/Nubbin Slough and lower Kissimmee River basins. Maintenance of field equipment.

1979 to 1989 - Park Attendent 2, Okee Tantie Park. Responsible for park maintenance and coordination of overnight camping for the general public.

Education: 1981 - Indian River Community College. Completed 140 hours of classroom and lab work for a certificate in wastewater management.

GREGORY J. SAWKA
Research Environmentalist

Area of Specialization: Watershed monitoring evaluation, quality control and data interpretation, soil interpretations, soil mapping and spatial variability.

Experience: South Florida Water Management District

1989 - Present: Research Environmentalist, Water Quality Division. Perform water quality data interpretations, prepare technical reports and QA/QC documentaion. Conduct water quality computer modeling.

Citrus County Planning and Zoning Department

1988 - 1989: Environmental Specialist/Planner. Responsible for preparing county ordinances and permit evaluation in areas of environmental concern including dredge and fill permits, wetland mitigation, and landfill siting.

Southeast Soil & Environmental Service, Inc.,
Gainesville, FL

1984 - 1988: Private Soil Consultant. Provide soil analysis, testing and interpretation involving land development, research projects, and environmental litigation.

University of Florida, Gainesville, FL

1986 - 1988: Research Soil Scientist. Served as a grant proposal member involving studies in seasonal water movement in soils and detailed soil mapping and interpretations.

1983 1986: Graduate Research Assistant. Evaluated Florida soils for on-site sewage disposal systems and water table drainage class analysis. Assist in soil training programs for FDHRS field personnel.

Missouri Department of natural Resource, Calloway
County, MO

1980 - 1983: Soil Scientist. Served as a member of Soil Conservation Service soil survey party. Duties include mapping and classifying soils, supervision and training, public relations, promotion and development of soil surveys and soil and other conservation projects.

Education:

M.S. - Soil Science, 1986, University of Florida, Gainesville, FL

B.S. - Environmental Science, 1978, Southampton College, Southampton, NY

A.S. - Oceanographic Technology, 1974, Florida Institute of Technology, Jensen Beach, FL

Professional Organizations:

American Water Resources Association - Florida Section

Florida Association of Professional Soil Classifiers

Soil Conservation Society of America

Soil Science Society of America

Certification:

Certified Professional Soil Scientist (ARCPACS 1986-1989)

MARY LOU DANIEL
Director, Chemistry Laboratory Division

Area of Specialization: Laboratory management, nutrient analysis, atomic absorption spectrophotometry.

Experience: South Florida Water Management District

1985 - Present - Division Director, Chemistry laboratory division. Responsible for the management of the chemical laboratories including budgeting, personnel and scheduling of services.

1981 - 1985 - Supervising Professional-Chemist, Water Chemistry Division. Responsible for the supervision of the chemistry laboratory including the scheduling of analyses, ordering of supplies and routine personnel matters.

1978 - 1981 - Analytical Chemist II, Water Chemistry Division. Responsible for the analysis of nutrients and physical parameters, the ordering of supplies, and supervision of technicians at a remote laboratory.

Harmon Engineering, Auburn, Alabama

1974 - 1976 - Chemist. Responsible for the routine analysis of air and water samples.

Environmental Science and Engineering, Inc., Gainesville, Florida

1972 - 1974 - Chemist. Responsible for the routine analysis of air and water samples.

Education: — — M.S. - Analytical Chemistry, 1981
Auburn University, Auburn, Alabama

B.S. - Chemistry (ACS), 1972
Waynesburg College, Waynesburg, Pennsylvania

Professional Affiliations: American Chemical Society
Florida Society of Environmental Analysts
Florida Academy of Sciences

LESLIE W. TEETS
Laboratory Quality Assurance Officer

Area of Specialization: Laboratory quality assurance and atomic absorption spectroscopy.

Experience: South Florida Water Management District

1989 - Laboratory Quality Assurance Officer, Chemistry Laboratory Division. Responsible for laboratory Quality Assurance program; cation and trace metal analyses; and field QC spike preparation and data compilation.

1987 - 1989 - Staff Chemist, Chemistry Laboratory Division. Responsible for the laboratory Quality Assurance program, cation and trace metal analyses, and field QC spike preparation.

1985 - 1987 - Chemist, Chemistry Laboratory Division. Responsible for the laboratory quality assurance program, cation and trace metal analyses.

1984 - 1985 - Laboratory Technician III, Water Chemistry Division. Responsible for cation and trace metal analysis and method development.

1981 - 1984 - Laboratory Technician I and II, Water Chemistry Division. Responsible for sample preparation, nutrient analyses, and physical parameters.

Education: B.S. Chemistry (ACS) - 1981
Stetson University, Deland, Florida

Professional Affiliations: American Chemical Society
Florida Society of Environmental Analysts
Association of Official Analytical Chemists

CAROLE A. MILLIMAN

Staff Chemist

Area of Specialization: Atomic absorption spectrophotometry, high pressure liquid chromatography, gas chromatography, and laboratory supervision.

Experience: South Florida Water Management District

February 1989 - Present - Staff Chemist, Chemistry Laboratory Division. Responsible for trace metal analyses by furnace atomic absorption spectrophotometry.

Wyeth Nutritionals, Division of American Home Products, Georgia, Vermont

1988 - 1989 - Laboratory Supervisor, Chemistry Laboratory. Responsible for supervision of chemistry, microbiology and instrument laboratories including routine personnel matters, scheduling of analyses to accommodate production while attempting to ensure the quality of the product - infant formula.

City of Jacksonville Bio-Environmental Services, Jacksonville, Florida

1987 - 1988 - Laboratory Technician, Water Chemistry Laboratory. Responsible for nutrient analyses using an auto-analyzer, and for physical parameters. Also responsible for some sample preparation and gas chromatography.

Ross Laboratories, Division of Abbott Laboratories, Sturgis, Michigan

1981 - 1986 - Analytical Laboratory Technician, Chemistry Laboratory. Responsible for mineral analyses using flame/furnace atomic absorption spectrophotometry, vitamin analyses using high pressure liquid chromatography, physical parameters and various other wet chemical procedures to ensure the quality of the infant formula. Also analyzed water for organics by gas chromatography.

Education: B.S. Chemistry - 1988
Jacksonville University, Jacksonville, Florida

THOMAS A. RAISHE
Laboratory Data Systems Supervisor

Area of Specialization: Management of computer resources used in the chemistry laboratory, (hardware and software).

Experience: South Florida Water Management District

1986 - Present - Laboratory Data Systems Supervisor, Chemistry Laboratory Division. Responsible for the management of computer resources used by the laboratory: Perkin-Elmer 3230 LIMS 2000, IBM PC's, Perkin-Elmer 7500, and associated peripherals; the maintenance of the laboratory data base and all systems software.

1984 - 1986 - Systems Programmer I, Water Chemistry Division. Responsible for the installation of the Perkin-Elmer 3230 computer and all associated software, the conversion and maintenance of existing Fortran programs from the Cyber to the PE 3230, and development of Fortran application programs needed to interface instruments and handle additional parameters.

1982 - 1984 - Data Manager, Water Chemistry Division. Responsible for management of the batch mode processing of laboratory data using the CDC Cyber computer.

1977 - 1982 - Data Management Analyst, Water Chemistry Division. Responsible for maintenance of the chemistry data base on the Cyber computer.

1976 - 1977 - Administrative Assistant, Water Chemistry Division. Responsible for the maintenance of electronic instruments used by the division to collect in situ test parameters: pH, specific conductance, temperature and dissolved oxygen.

— — 1972 - 1976 - Engineering Aide, Environmental Sciences Division. Responsible for routine water sample collection of various projects.

Education: A.S. Science
Flint Community College, Flint, Michigan

Electronics Technology, 1975 - 1977 (correspondence)
DeVry Institute of Technology

PATRICIA A. HUGHEY
Lab Data-Entry Technician

Area of Specialization: Using LIMS module, entering manual data, collect and file printouts, generate CHO2 and CHO4 reports on a weekly basis.

Experience: South Florida Water Management District

1988 - Present: Lab Data-Entry Technician - responsible for accurately entering data from Field Log Sheet, generate CHO2 and CHO4 reports, generate labels for logged-in samples and, attach labels to the correct sample bottles.

Kelly Temporary Service, North Palm Beach, Florida

1987 - 1988: Duties included various clerical positions - general office responsibilities.

Treasure Coast Publishing, Jupiter, Florida

1986 - 1987: Duties included answering the telephones, sorting mail, placing ads with various newspapers, data-entry.

U.S. Post Office, West Palm Beach, Florida

1985 - 1986: Duties included sorting mail by zip code, and distributing to correct zip code slots, transferring mail from one operation to another, weighing mail.

Education: New England Institute Technology, 1988
West Palm Beach, Florida

Additional courses at Palm Beach Junior College:
Computer Programming

LORI A. PERKOWSKI
Laboratory Analyst

Area of Specialization: Nutrient analysis, wet chemical procedures using continuous flow analyzers.

Experience: South Florida Water Management District

1986 - Present - Laboratory Analyst, Chemistry Laboratory Division. Responsible for nutrient analyses using AutoAnalyzers RFA 300, and Dionex 4000I Ion Chromatograph.

1985 - 1986 - Laboratory Technician II, Water Chemistry Division. Responsible for wet chemical analyses and nutrient analyses.

UPACO Adhesives, Nashua, New Hampshire

1981 - 1985 - Laboratory Technician. Responsible for the quality control of adhesive products and R & D support.

Education: A.S. Medical Laboratory Technology, 1982
Rivier College, Nashua, New Hampshire

Professional Affiliation: American Society of Clinical Pathologists

CAROL L. LEVINE
Laboratory Analyst

Area of Specialization: Flame atomic absorption techniques, trace metal sample preparation, graphite furnace.

Experience: South Florida Water Management District

1988 - Present - Laboratory Analyst. Flame atomic absorption analysis and trace metal digestions.

1985-1988 - Laboratory Technician, Chemistry Laboratory Division. Responsible for flame atomic absorption analyses, trace metal digestions, and physical parameters. As and Zn analysis.

Education: Medical Laboratory Technician Certification
Bethesda-Kennedy Hospitals Program

Palm Beach Junior College
A.S. Medical Laboratory Technology

Professional Affiliation: National Certification Agency for Medical Laboratory Personnel (CLT), #0923151 1988
Palm Beach Jr. College

**HENRY ALEXANDER
TECHNICIAN SUPERVISOR AND LABORATORY SAFETY COORDINATOR**

Area of Specialization: Analysis of and supervising analysis of nutrients, anions, and cations using flow injection continuous flow techniques, and atomic absorption. Laboratory safety procedures.

Experience: South Florida Water Management District

1988 - Present - Technician Supervisor, Chemistry Laboratory Division. Responsibilities include supervising and training technicians in the analysis of water samples for nutrients and anions using flow injection and continuous flow techniques. Maintain and repair instrumentation and train technician in maintenance and repair.

1985 - 1988 - Laboratory Analyst, Chemistry Laboratory Division. Responsibilities include the analysis of water samples for nutrients and anions using flow injection and continuous flow techniques.

IMC, New Wales, Florida

1975 - 1985 - Chemical Analyst. Responsibilities included method development, instrument evaluation, and nonroutine analysis of phosphate fertilizer and its by-products.

J&W Chemical, Belle Glade, Florida

1970 - 1973 - Laboratory Technician. Responsibilities included analyzing a variety of samples for several components.

Education: — — Chemistry Major (3 years)
University of South Florida

MARY ANN KRSNICH
Laboratory Analyst

Area of Specialization: Sample preparation, physical parameters, and nutrients by continuous flow techniques.

Experience: South Florida Water Management District

April, 1988 - Present - Laboratory Technician
Responsible for physical parameters, sample preparation and fluoride analysis.

State of Florida Department of Agriculture & Consumer Services

1985 - 1988 - Laboratory Technician III. Analyzed gasoline, diesel & aviation fuel for volatility by distillation methods (manual & automatic).

Kurth Malting Company, Milwaukee, WI

1983 - 1985 - Laboratory Technician (Quality Control Lab) Miscellaneous analyses of malted barley; Kjeldahl protein, bacteria, diastatic power, alpha amylase, pH, specific gravity, insect infestations, color, growth counts, moisture and flavor tests.

Wisconsin Shippers, Milwaukee, WI

1982 - 1983 - Secretary-Receptionist. General secretarial duties

City Wide Insulation, Milwaukee, WI

1978 - 1982 - Clerk-typist. general office duties

PEDRO R. RODRIGUEZ-VAZQUEZ
Laboratory Analyst

Area of Specialization: Analysis of nutrients using continuous flow analyzers.

Experience: South Florida Water Management District

1988 - Present - Laboratory Analyst, Chemistry Laboratory Division - Responsibilities include the analysis of water samples for nutrients using flow injection techniques, physical parameters, and the maintenance of the water system.

1986 - 1987 - Laboratory Technician, Chemistry Laboratory Division. Responsible for the digestion and analysis of water samples for Kjeldahl nitrogen using the Technicon Auto-Analyzers, and analysis of physical parameters.

1985 - 1986 - Laboratory Technician I, Soil Lab, Water Chemistry Division. Responsible for grinding, digestion and analysis of soil and plant nutrients using the Technicon Auto-Analyzers.

Education: B.S. Natural Sciences (Biology), 1981
University of Puerto Rico, San Juan, Puerto Rico

Quantitative Analysis Chemistry Course, 1981
Inter American University of Puerto Rico, San German, Puerto Rico

JOSE L. VIDAL
Senior Chemist

Area of Specialization: Laboratory management, inorganic chemistry and inorganic analytical chemistry.

Experience: South Florida Water Management District

1987 - Present - Senior Chemist, Chemistry Laboratory Division. Responsible for supervising the first shift of the laboratory including personnel, ordering of supplies, and data review.

Westmoreland Coal Company, Gallagher Research Center, Beckley, West Virginia

1986 - 1987 - Director of Research. Responsible for staff supervision, budget administration, data quality and interaction with other divisions.

Union Carbide Corporation, South Charleston, West Virginia

1974 - 1985 - Research Scientist and Group Leader. Responsible for supervision of research group, synthesis and evaluation of new homogeneous catalysts, and development of methods for handling hazardous chemical wastes.

Education: Ph.D. Inorganic Chemistry, 1974
University of Florida, Gainesville, Florida

D.Sc. Inorganic Chemistry, 1969
University of Santiago, Spain

B.Sc. Chemistry, 1965
University of Santiago, Spain

DELORES BOATWRIGHT
Laboratory Technician

Area of Specialization: Physcial parameters (specific conductance) and TKN Digestion.

Experience: South Florida Water Management District

1987 - Present - Laboratory Technician, Chemistry Laboratory Division. Responsible for physical parameters, cleaning of laboratory glassware, sample bottles, and filter holders, and sample preparation.

Humana Hospital, West Palm Beach, Florida

1986 - 1987 - Duties included drawing blood and entering data into the computer.

Palm Beach Blood Bank, West Palm Beach, Florida

1982 - 1985 - Duties included taking and evaluating vitals of donors and lab work.

Presidential Women's Center, West Palm Beach, Florida

1982 - 1985 - Duties included taking and evaluating vitals of patients and lab work.

Education: Clinical laboratory Technician Certification
Charron Williams College, Ft. Lauderdale, Florida

Palm Beach Junior College, Lake Worth, Florida

Professional Affiliation: American Medical Technologist

MARK A. BARGERSTOCK

Laboratory Technician

Area of Specialization: Sample preparation and physical parameters.

Experience: South Florida Water Management District

1988 - Present - Laboratory Technician, Chemistry Laboratory Division. Responsible for Total Kjeldahl Nitrogen Digestion (TKN).

Lake Worth Medical Center, Lake Worth, Florida

1987 - 1988 - Duties included doing routine lab work on patients, and analyzing the patient's lab work.

Education: 1982 - 1984 Lenape Vo-Tech, Ford City, Pennsylvania

1984 - 1985 Penn State University

Internship at Allegheny Valley Hospital

Additional courses at South College and Palm Beach Community College.

WILLIAM C. DONOVAN
Supervising-Professional-Chemist

Area of Specialization: Laboratory management, soil chemistry and water quality analysis

Experience: **South Florida Water Management District**

1988 - Present - Supervising Professional-Chemist, Chemistry Laboratory division. Responsible for the supervision of the second shift of the laboratory including personnel, data review and ordering of supplies.

1986 - 1988 - Senior Water Use Engineer. Responsible for urban and agricultural water use conservation programs such as Xeriscape and drip-irrigation on sugarcane.

University of Florida - IFAS, Belle Glade Research/Education Center

1982 - 1986 - Sugarcane Extension Specialist: Responsible for the IFAS Belle Glade Soil Testing Lab Results, the development of a program on sugarcane production and functioning as a technical expert on sugarcane.

Ohio Agricultural Development and Research Center, Wooster, Ohio

1978 - 1982 - Research Associate. Determined the amount of ammonia volatilization from different sewage sludges under controlled conditions of temperature, soil type, soil moisture, and vegetative cover.

U.S. Naval Hospital, Portsmouth, Virginia

1971 - 1973 - Senior Coreman - Anesthesia Technician. Responsible for training, supplies, personnel and budgeting.

Education: **Ohio State University, Columbus, Ohio**
Ph.D. Soil Science - Soil Chemistry, 1982
M.S. - Natural Resource - Resource Management, 1976
B.S. Biology/Zoology, 1970

Professional Affiliations: Soil Science Society of America
American Society of Agronomy

CHARLES SCOTT
Laboratory Analyst

Area of Specialization: Nutrient analysis using continuous flow analyzers.

Experience: South Florida Water Management District

1988 - Present - Laboratory Analyst, Chemistry Laboratory Division. Responsible for nutrient digestions and analyses using RFA 300.

1987 - 1988 - Hydrogeologic Technician assisting in the well abandonment program throughout the district and the gathering of geologic data from old abandoned wells. Also the logging of new wells and the creation of a data base for water sources in the future.

(Summer) 1987 - Assisted in the tree removal program along the canal banks and water ways.

Miami Dade Community College Miami, FL

1981-1982 - Responsible for the sample, chemical and instrument preparation in the General Chemistry Student Laboratories.

Education: A.A. Chemistry and Physics with a minor in Mathematics, Miami Dade Community College, Miami, FL 1982.

SFWMD QA PLAN Section No. A Revision No. 2.0 August 1, 1989

APPENDIX A

COLOR

Equipment:

Spectronic 501 with ambient flowcell

Reagent:

Platinum - cobalt color standard, 500 APHA color units (Fisher #SO-P-120)

Standards:

1. 500 c.u. = undiluted stock reagent
2. 300 c.u. = 30 mLs stock diluted to 50 mLs with di H₂O
3. 100 c.u. = 10 mLs stock diluted to 50 mLs with di H₂O
4. 50 c.u. = 5 mLs stock diluted to 50 mLs with di H₂O

Procedure:

1. Calibration
 - a. Let instrument warm-up for 30 minutes.
 - b. The settings for the color procedure have been saved in the 501's memory and will be automatically set-up when the instrument is turned on. It should go to 465 nm as the proper wavelength.
 - c. Press "A" on the accessory module to activate the pump. Pump di H₂O through the flowcell until a stable reading is observed. Press "Second Function" and "%T/A/C" keys on the main keyboard to zero the instrument.
 - d. Pump the 500 c.u. standard through the flowcell until a stable reading of 500 +/-5 c.u. is obtained. If a reading of 500 +/-5 c.u. is not obtained, consult the instrument manual or your supervisor for the recalibration procedure.
 - e. Record the calibration results on the calibration log sheet in the notebook.
 - f. Check the remaining standards using the procedures in d and e. The 300 c.u. standard should read 300 +/-5 c.u.. The 100 c.u. standard should read 100 +/-3 c.u.. The 50 c.u. standard should read 50 +/-3 c.u..

Color Procedure

2. Sample Measurement

- a. Sample should be at or near room temperature to prevent condensation on the flowcell.
- b. Pump sample through the flowcell until the reading is stable. It takes approximately one milliliter of sample to get a stable reading.
- c. Record the reading on the computer sheet for manual data entry.
- d. Check a standard after every 10 samples. If the result is not correct, check with your supervisor before continuing with the analysis of samples.

General Description:

The color of the sample is determined by spectroscopic comparison to platinum-cobalt standard solutions. The use of spectroscopy allows more samples to be analyzed and it also eliminates the variation in color readings taken by the human eye reducing the potential for error in the test. The method is applicable to waters which are colored naturally due to vegetative decay. One unit of color corresponds to 1 mg/L platinum in the form of the chloroplatinate ion.

Samples

The samples matrices analyzed using this procedure are limited to ambient surface water, groundwater, rainfall and agricultural storm water runoff.

APPENDIX B

SULFATE

Instrumentation and Equipment

Dionex Series 4000i Basic Chromatography Module;
Dionex Eluent De-gas module;
Dionex Conductivity Detector
Dionex IonPac™ Column, HPIC-AG4A
Helium gas; Industrial grade, 99.95% minimum purity

Samples

The samples matrices analyzed using this procedure are limited to ambient surface water, groundwater, rainfall and agricultural storm water runoff.

Reagents

Eluent: 0.4705 NaHCO₃ + 0.4665g Na₂CO₃ diluted to 2L with di water; made fresh daily

Regenerate: 2.ml concentrated H₂SO₄ diluted to 400 ml with di water; diluted further with di H₂O in regenerate bottle provided with instrument; final volume = 4 liters; made fresh daily.

Standards

Stock solution = 0.3697 g Na₂SO₄ (dried analytical grade) diluted to 250 ml with di water = 1000 mg/L SO₄

Standards:

S1: 200 mg/L = 10 ml stock, dilute to 50 mls

S2: 100 mg/L = 5 ml stock, dilute to 50 mls

S3: 20 mg/L = 1 ml stock, dilute to 50 mls

Standard Additions

1.0 ml SO₄ stock diluted to 10 mls with sample = sample concentration plus 100 mg/L SO₄

Procedure

1. Instrument set-up
 - a. Set the Auto-Sampler to LOCAL
 - b. Start PROGRAM 2 on the gradient pump
 - c. Conductivity detector cell output range = 300 μ S
 - d. Turn on eluent degas module
 - e. Turn on helium gas; pressure should be 80-120 psi on line
 - f. Adjust regenerate knob to read 5 psi

2. Auto-Sampler & Sample Preparation

- a. The first rack on the Auto-Sampler should contain standards and samples in the following order: #1 = S1; #2 = S2; #3 = S3; #4 = QC1; #5 = QC2, #6 = sample used to prepare the standard addition. The second rack should contain the standard addition in #1 and the repeat sample in #2; a di water blank is placed in #3 and analyzed to check the calibration and for possible contamination.
- b. Fill each sample cup to the 5ml mark and cover with filter cap
- c. Use tool provided to fully depress filter cap so it is level with the top of the sample cup
- d. Keeping the white dot at the end of the rack on your right, sample cups are placed in 6 sample cup racks going from right to left (position 1 to position 6)
- e. Place the filled sample racks behind the pressure plate in the left hand compartment of the Auto-Sampler.

3. Integrator Sample Listing

- a. Each key on the integrator has a minimum of 3 characters assigned to it; the condition of the EDIT A indicator light is used to designate which characters are functional as described below:
 1. • EDIT A - light is on: characters in blue on the bottom of the key are functioning;
 2. EDIT A - light is on and blinking rhythmically: upper left hand characters in black on key are functioning.
 3. * EDIT A - light is on and flickering erratically: use the SHIFT key to toggle back and forth between the 3 functions of EDIT A.
- b. Press Integrator ENTER key until the following line appears on the printer:
SAM IDX NAME SAM AMT SCALE FACTOR
SI =
- c. Press 1 , ENTER, and SHIFT (to change to •EDIT A) key in the sample number
- d. Press ENTER 3 times to return to the next line which will begin with SI =
- e. Complete steps c. and d. until all samples and quality control samples are entered; the calibration standards are part of the analytical program and are not entered as samples in the sample listing.
- f. After all samples are entered and SI = appears on the printer, Press ENTER to end the sample list. END OF DIALOG should appear on the printer.

4. Start

- a. Activate the RUN key on the Auto-Sampler
- b. On the integrator, press CALIBRATE, 1, ENTER (EDIT A light should be on)

- c. Press INJ B
- d. Enter the number of samples plus the 3 calibration standards, then press ENTER
- e. Respond to the STATUS MODE prompt by entering 0.

5. Calibration

- a. The retention times for each standard is compared to historical values and must fall within $\pm 10\%$ of the program value of 2.25 minutes. Additionally, the peak area of each standard is compared to historical values as a means of monitoring instrument response. When peak areas deviate by more than $\pm 10\%$ of the historical values, the analyses is aborted and further analyses are suspended until the problem is corrected.
- b. Retention times deviating outside the range stated above are not acceptable; in such a case, the standards are not accepted and the run is aborted. The reagents may be prepared again and the column may be replaced in order to obtain acceptable retention times.
- c. Peak areas for each standard are recorded on the Calibration Log for Physical Parameters form.

6. Quality Control Samples

- a. The frequency of analyses for each type of quality control sample as given in the Laboratory Quality Assurance Manual is as follows:
 - (1) Calibration standards = every 20 samples
 - (2) QC1 and QC2 = at the beginning of every run
 - (3) Standard additions (a different sample is used to prepare each standard addition) = every 20 samples
 - (4) Repeat sample = every 10 samples
- b. The maximum length of any run = 33 samples
- c. All quality control samples must fall within the ranges given in the most recent update of the Acceptable Limits for QC Samples memo.

Sulfate

A. ERA Proficiency Sample Results - obtained using Method 300.0

DATE	STUDY	SAMPLE	OUR VALUE, mg/L	"TRUE VALUE", mg/L
8/87	WP019	WP686-1	72.8	74.0
		WP686-2	31.9	33.0
2/88	WP020	WP686-1	7.55	5.01
		WP686-2	120.0	120.0
8/88	WP021	WP788-1	15.3	15.1
		WP788-2	110.9	116.0
2/89	WP022	WP788-1	36.35	38.0
		WP788-2	8.65	6.10

B. Comparison Data

Sample	Method 375.2*	Ion Chromatograph
87001102	5.9	10.643
87001109	13.8	12.817
87001110	18.5	17.409
87001727	93.160	80.9736
87001728	89.20	77.658
87001772	35.623	33.1425

*Method 375.2 does not give a linear calibration although the method treats it that way which causes errors.

C. U.S.G.S. Round Robin Sample Results

DATE	USGS SAMPLE	USGS VALUE	OUR VALUES	
			METHOD 375.2	ION CHROMATOGRAPH
1/87	M96	138.5	161.1	132.5
7/87	M98	41.3	39.0	
7/87	M100	1154.	1200.	
1/88	M102	414.4		410.
8/88	M104	224.1		230.
8/88	M106	27.6		27.
2/89	M108	184.		183

(all concentration values are mg/L)

D. Quality Control Results

1. Laboratory Quality Control Results

Quality Control results for each quality control sample are compiled for each parameter on a quarterly basis. Copies of the graphs for SO₄ quality control samples for each quarter of the 1988 calendar year are provided at the end of this Appendix.

- a. QC1 is prepared from sulfate standards purchased from HACH Company, Inc. The standard is diluted to prepare a sample whose final concentration is near the lowest standard.
- b. QC2 is a composite solution purchased from Environmental Resource Associates. The SO₄ concentration in these samples will vary depending on the lot; past values have ranged from 136 mg/L to over 200 mg/L. The sample is diluted by the analyst when the value exceeds the high standard concentration.
- c. The repeat sample is a randomly chosen sample; a different sample is used on a daily basis. In order to make meaningful comparisons between each repeat sample, the coefficient of variation (also known as %RSD) is calculated for each days repeat readings. These CV values are graphed to show instrument variability over time. For sulfates, CV values must be less than or equal to 5.0 to be considered acceptable.
- d. The per cent recovery for each standard addition is calculated. These values are compiled and graphed each quarter and used to assess the ability to detect analyte within various matrices.

2. Field QC Results

- a. Field Spiked Samples - since a known amount of analyte is added to each field spike sample, these results may be evaluated as per cent recovery values. The results are used much the same as standard addition values in that they are used to assess the accuracy of the method in each type of matrix. The percent recovery values for SO₄ on field spiked samples since January 1988 are listed in Table B.1.

Table B.1. SO₄ Field Spike Recoveries Obtained Using Ion Chromatography

Results:

<u>Date</u>	<u>Sample Type</u>	<u>% of SPIKE Recovered</u>
1/6/88	Groundwater	83.5
1/13/88	Surface water	97.5
2/22/88	Groundwater	99.4
2/29/88	Seawater	95.7
3/24/88	Surface water	92.9
4/12/88	Surface water	90.9
4/12/88	Surface water	94.2
4/18/88	Surface water	96.3
4/19/88	Surface water	101.3
4/20/88	Surface water	98.0
4/21/88	Groundwater	96.2
4/25/88	Surface water	98.9
4/27/88	Surface water run-off	90.5
5/2/88	Groundwater	97.0
5/9/88	Surface water	82.2
5/10/88	Groundwater	101.6
5/17/88	Surface water	88.4
5/19/88	Groundwater	93.0
5/23/88	Surface water	96.7
5/24/88	Surface water	98.7
5/24/88	Surface water	101.9
5/25/88	Surface water	93.1
5/26/88	Surface water run-off	95.3
5/27/88	Estuarine water	108.2
6/2/88	Estuarine water	101.9
6/7/88	Surface water	95.3
6/6/88	Surface water	95.6
6/6/88	Surface water	96.8
6/8/88	Surface water	93.4
6/20/88	Surface water	94.0
6/21/88	Surface water	86.4
6/23/88	Groundwater	96.4
6/28/88	Groundwater	101.1
7/6/88	Surface water	98.4
7/8/88	Surface water	98.9
7/5/88	Surface water	97.2
7/11/88	Estuarine water	100.1
7/11/88	Surface water	100.4
7/12/88	Estuarine water	100.0
7/14/88	Surface water	83.2
7/14/88	Surface water	94.5
7/18/88	Surface water	99.1

7/19/88	Estuarine water	65.0
7/20/88	Groundwater	100.0
7/25/88	Surface water	99.7
7/27/88	Groundwater	68.4
7/29/88	Estuarine water	87.5
8/4/88	Surface water	101.1
8/15/88	Surface water	96.1
8/16/88	Groundwater	91.9
8/17/88	Surface water	96.8
8/29/88	Surface water	97.1
8/30/88	Surface water	94.3
9/12/88	Surface water	95.3
9/15/88	Surface water	99.7
9/26/88	Surface water	95.1
9/28/88	Groundwater	91.6
10/10/88	Surface water	92.8
10/17/88	Surface water	93.3
10/18/88	Surface water	92.0
10/19/88	Surface water	89.3
10/19/88	Surface water	90.7
10/25/88	Surface water	94.1
10/25/88	Surface water	100.0
10/26/88	Groundwater	94.9
10/27/88	Groundwater	92.3
11/21/88	Surface water	95.7
11/22/88	Surface water	97.2
11/22/88	Surface water	96.3
12/1/88	Groundwater	96.8
12/5/88	Surface water	100.4
12/14/88	Groundwater	100.1
12/19/88	Surface water	102.9
12/21/88	Surface water	97.4

JANUARY - MARCH 1988

S04 QC1 = 25.0

AVERAGE VALUE = 25.3387

STANDARD DEVIATION = 0.419728

95% CONFIDENCE LIMIT = ± 0.839457

TEST: S04

MINIMUM VALUE = 24.6

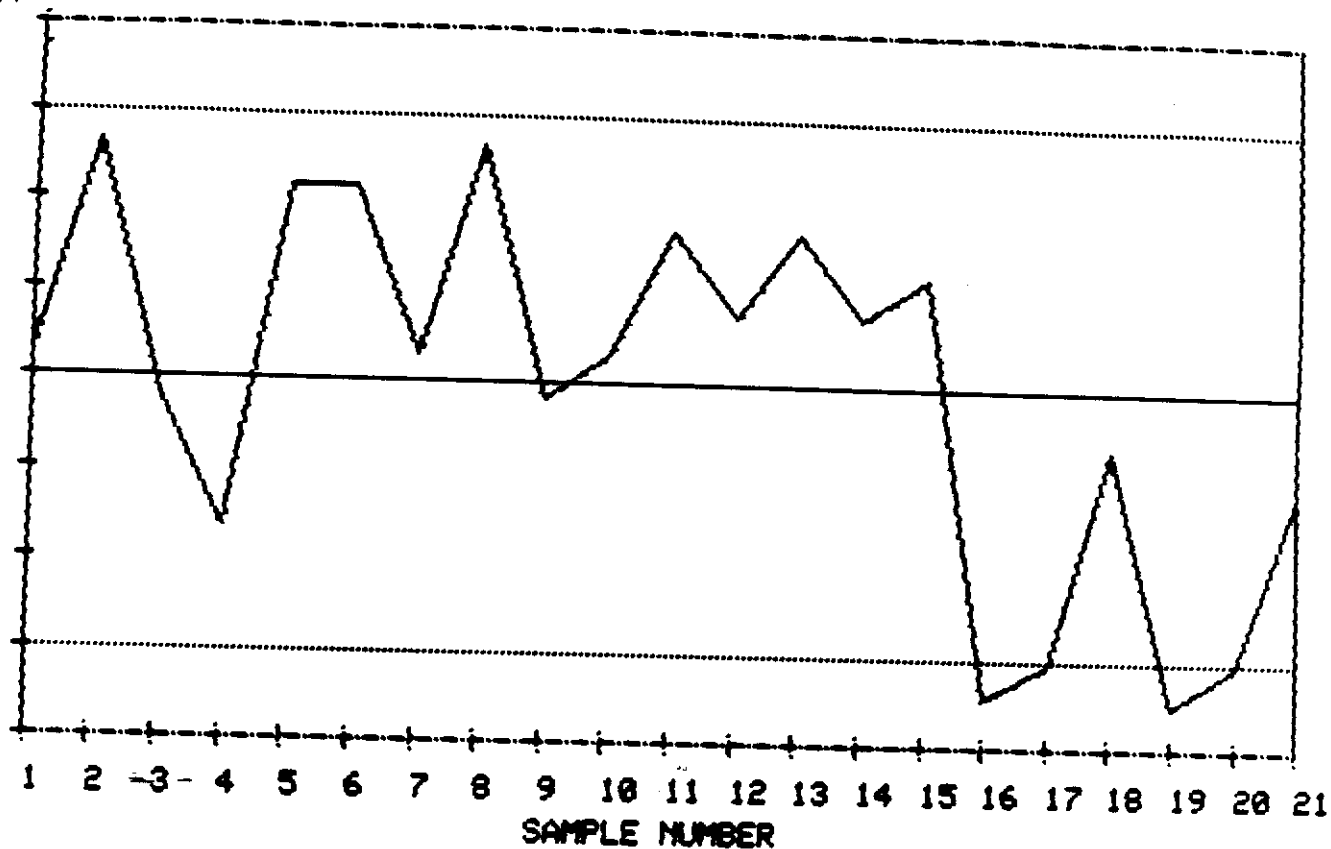
MAXIMUM VALUE = 25.9

POPULATION = 21

UPPERLIMIT
26.1782

AVERAGE
25.3387

LOWERLIMIT
24.4993



OTHER FILE (Y/N) : _

JANUARY - MARCH 1988

S04 QC2A = 136

AVERAGE VALUE = 136.179

STANDARD DEVIATION = 1.53885

95% CONFIDENCE LIMIT = ± 3.0777

TEST: S04

MINIMUM VALUE = 132.5

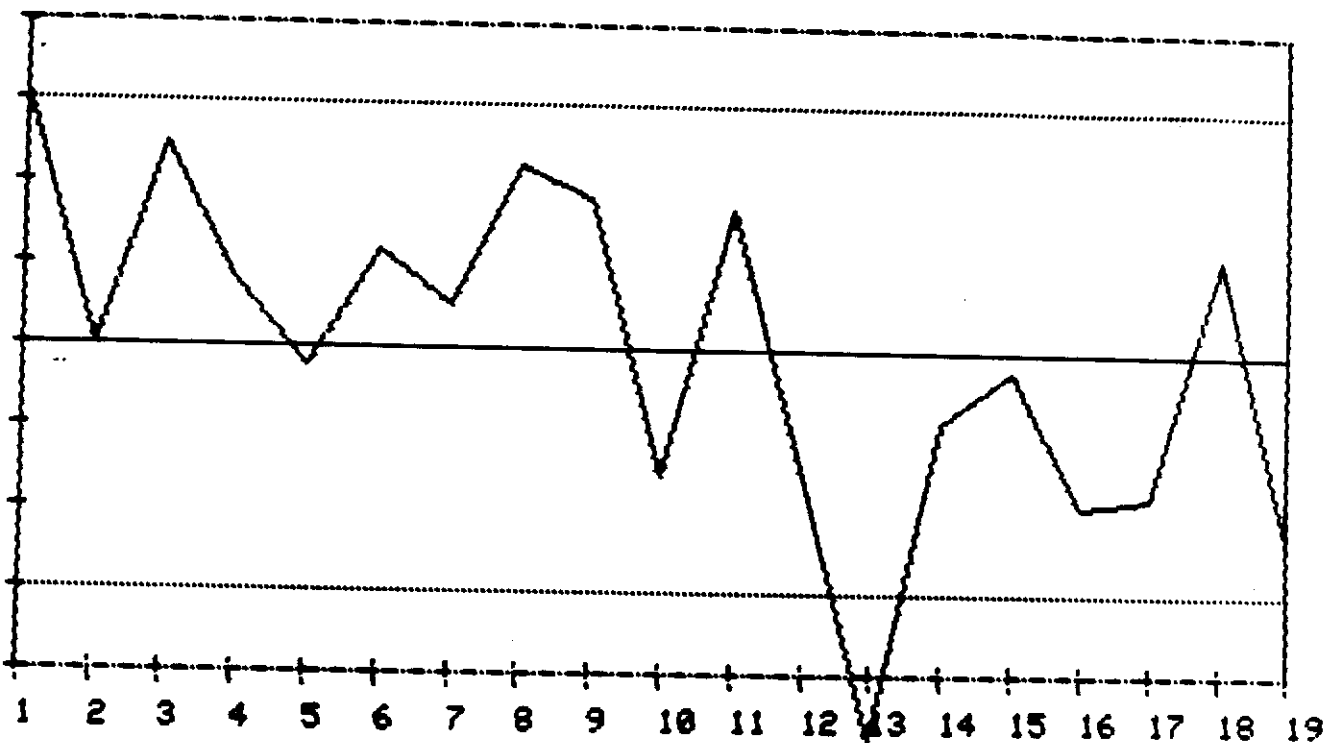
MAXIMUM VALUE = 138.6

POPULATION = 19

UPPERLIMIT
139.257

AVERAGE
136.179

LOWERLIMIT
133.102



SAMPLE NUMBER

ANOTHER FILE (Y/N) : _

JANUARY - MARCH 1988

304 QC2B = 126

AVERAGE VALUE = 184.2

STANDARD DEVIATION = 0.57735

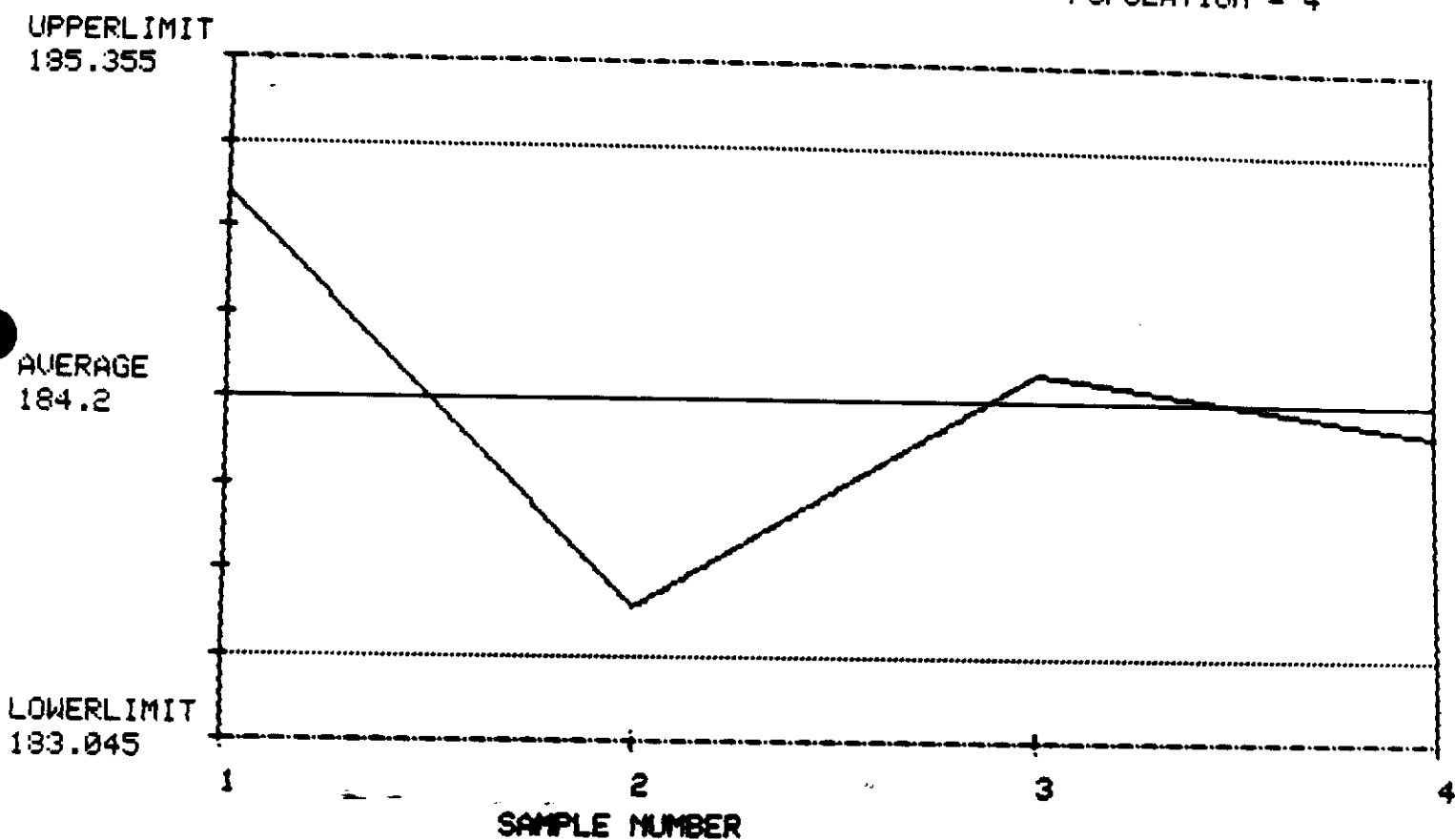
95% CONFIDENCE LIMIT = ± 1.1547

TEST: 304

MINIMUM VALUE = 183.5

MAXIMUM VALUE = 184.9

POPULATION = 4



ANOTHER FILE (Y/N) : _

JANUARY - MARCH 1988

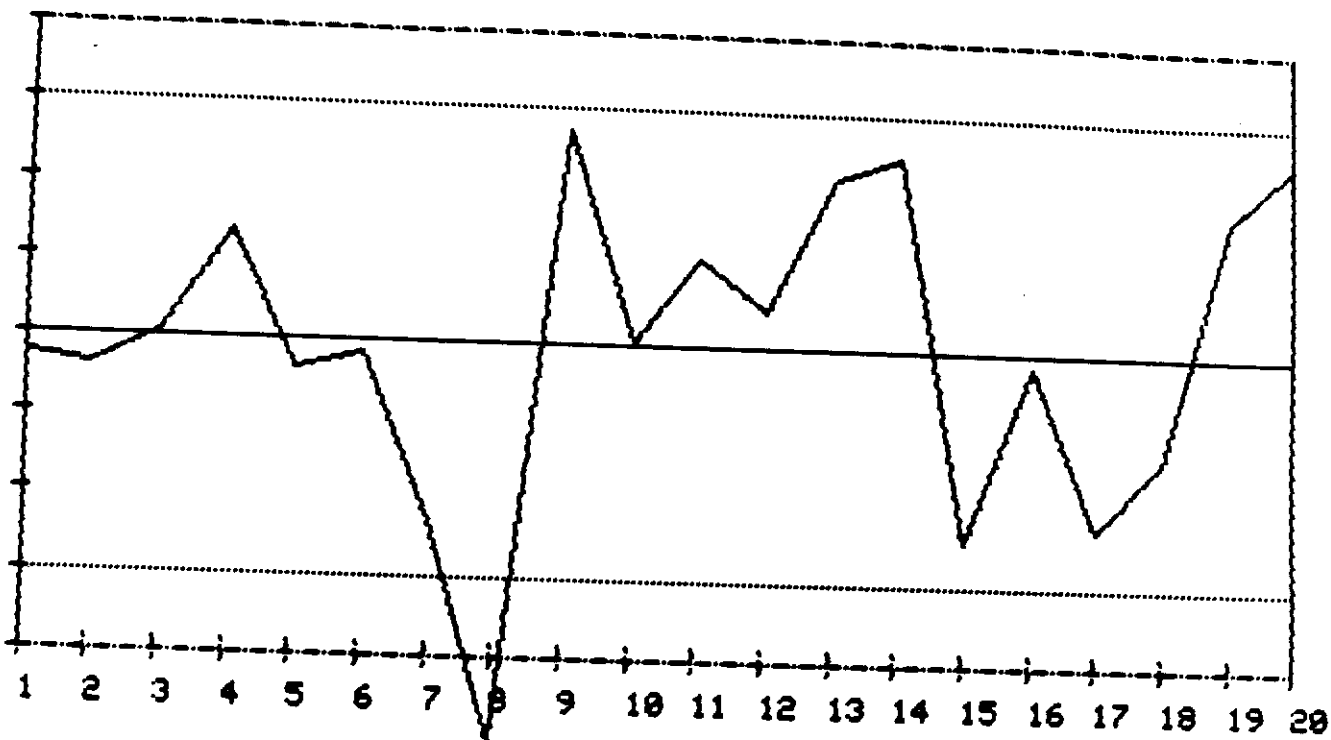
S04, STANDARD ADDITIONS
AVERAGE VALUE = 100.345
STANDARD DEVIATION = 2.96637
95% CONFIDENCE LIMIT = ± 5.93274

TEST: S04
MINIMUM VALUE = 92.3
MAXIMUM VALUE = 104.4
POPULATION = 20

PERLIMIT
6.278

VERAGE
0.345

PERLIMIT
4123



SAMPLE NUMBER

OTHER FILE (Y/N) : _

JANUARY - MARCH 1988

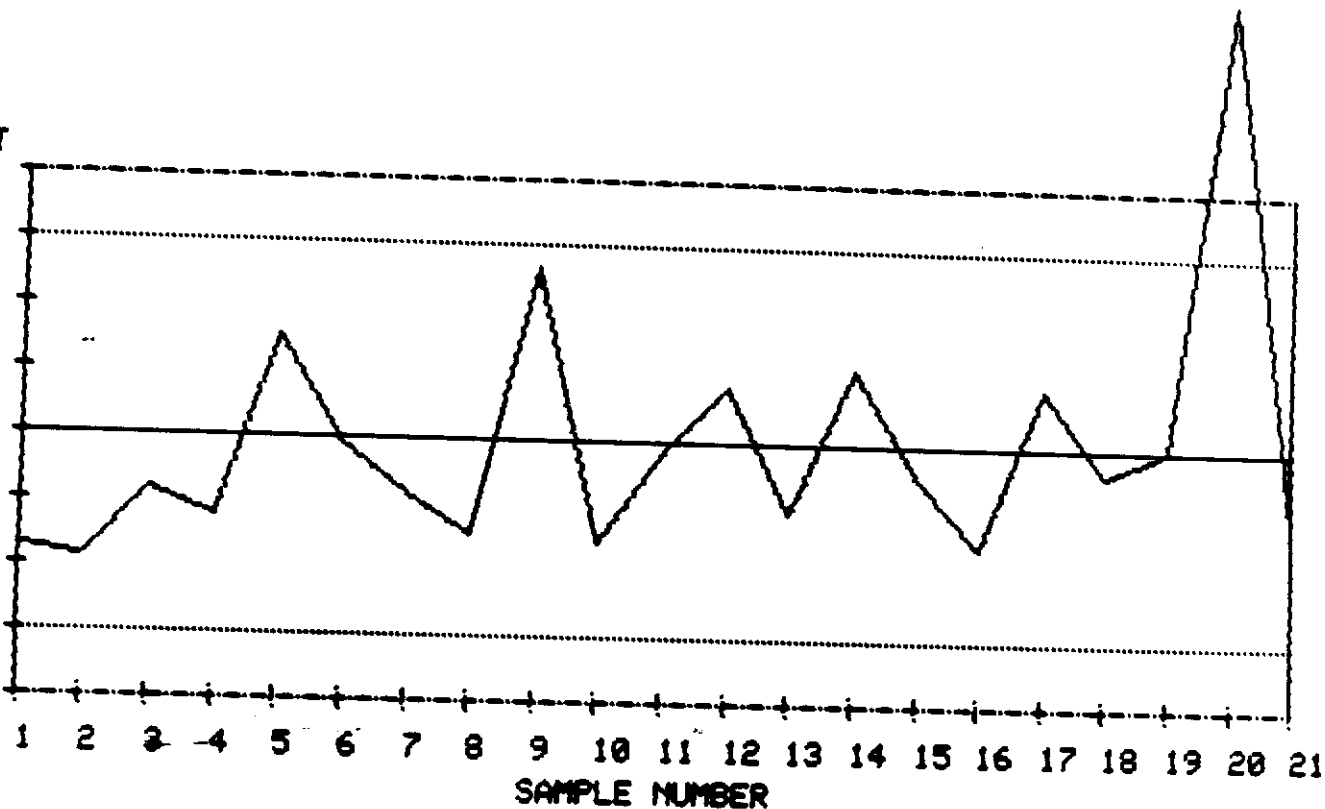
SQ4 COEFFICIENT OF VARIATION
AVERAGE VALUE = 0.533857
STANDARD DEVIATION = 0.538765
95% CONFIDENCE LIMIT = ± 1.07753

TEST: SQ4
MINIMUM VALUE = 0.042
MAXIMUM VALUE = 2.42
POPULATION = 21

UPPERLIMIT
1.61139

AVERAGE
0.533857

LOWERLIMIT
0.543673



MOTHER FILE (Y/N) : _

APRIL - JUNE 1988

S04 QC 1 = 25.0

AVERAGE VALUE = 24.6913

STANDARD DEVIATION = 0.222572

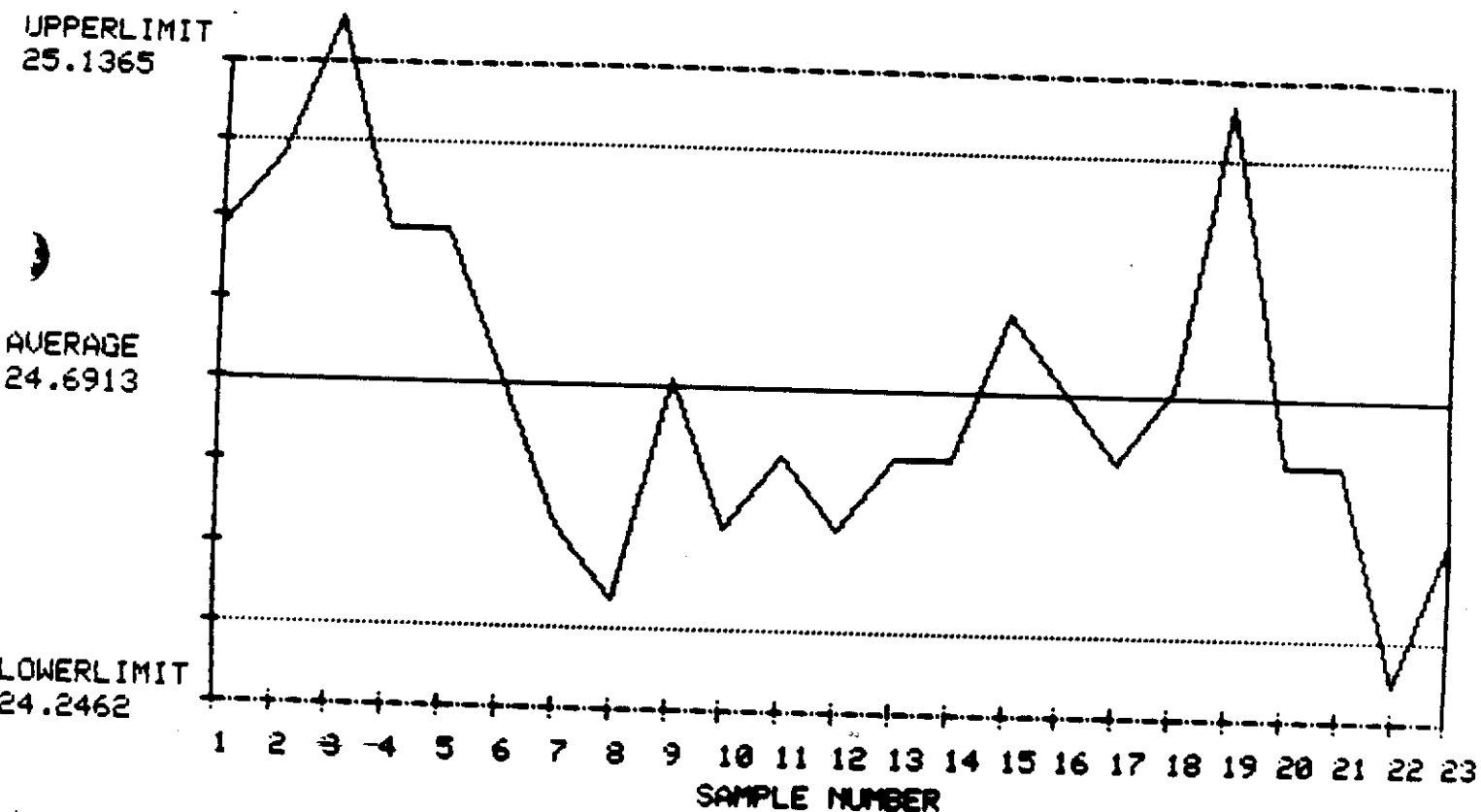
95% CONFIDENCE LIMIT = ± 0.445144

TEST: S04

MINIMUM VALUE = 24.3

MAXIMUM VALUE = 25.2

POPULATION = 23



ANOTHER FILE (Y/N) : _

APRIL - JUNE 1988

S04 QC 2 = 186.

AVERAGE VALUE = 183.161

STANDARD DEVIATION = 1.29136

95% CONFIDENCE LIMIT = ± 2.58272

TEST: S04

MINIMUM VALUE = 181.0

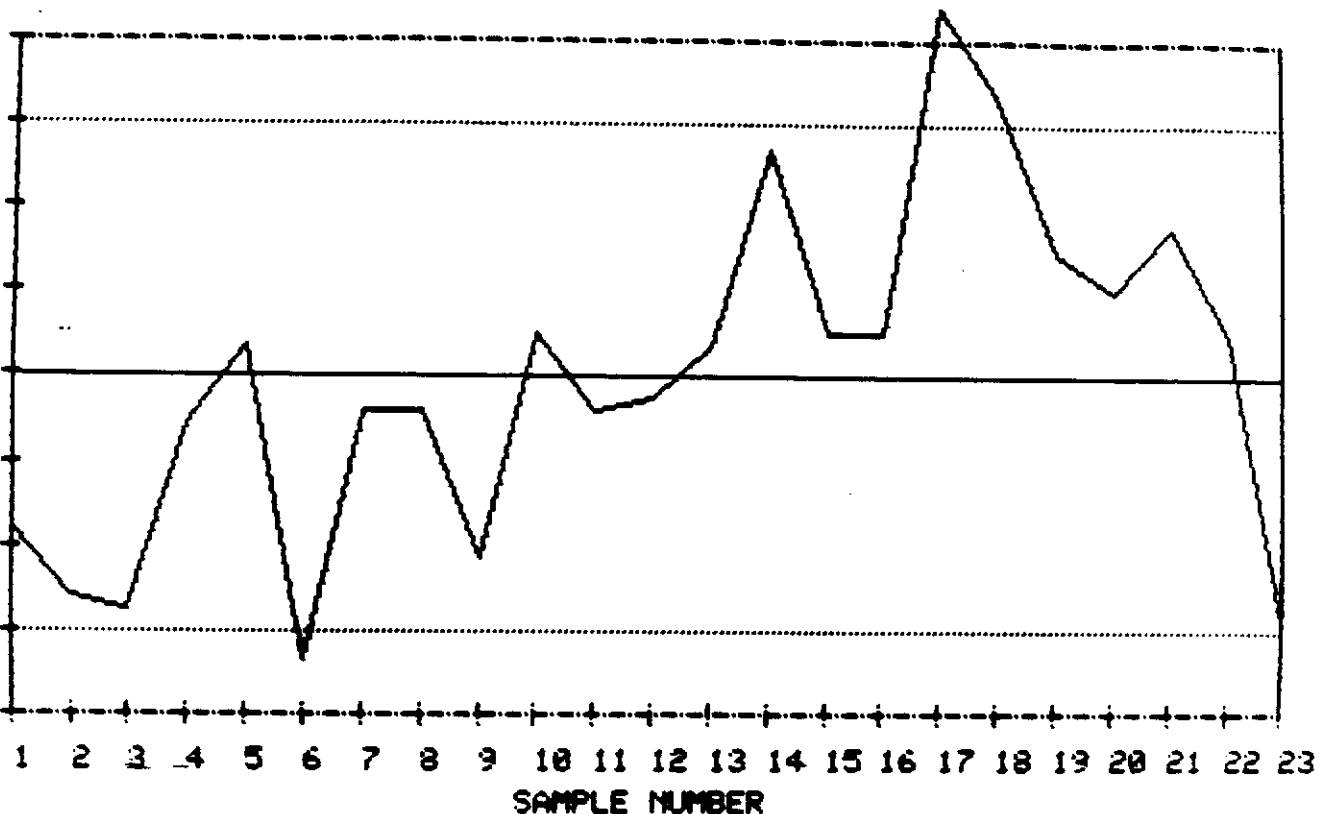
MAXIMUM VALUE = 186.0

POPULATION = 23

UPPERLIMIT
185.744

AVERAGE
183.161

LOWERLIMIT
180.578

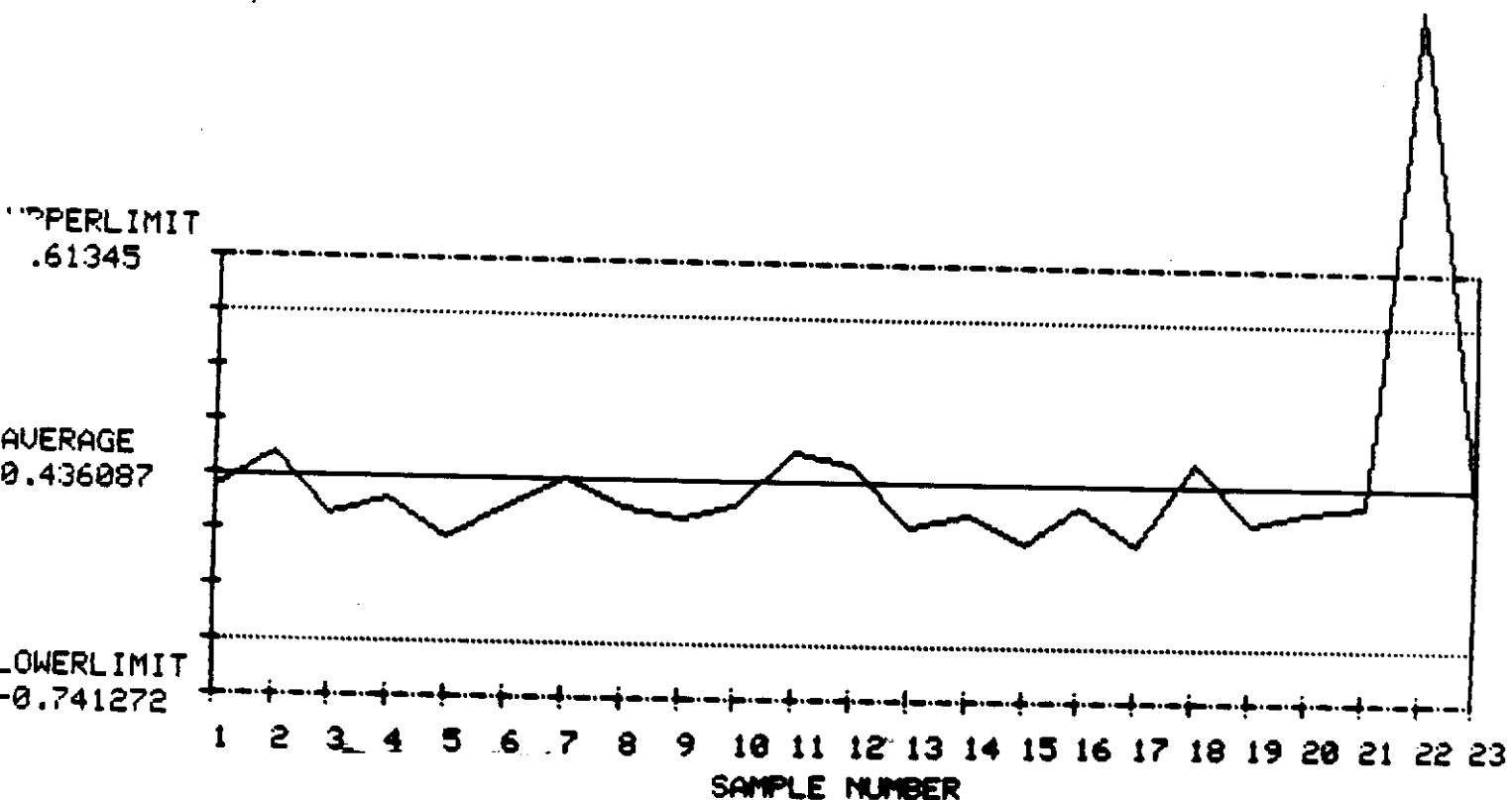


ANOTHER FILE (Y/N) : _

APRIL - JUNE 1988

S04 COEFFICIENT OF VARIATION
AVERAGE VALUE = 0.436087
STANDARD DEVIATION = 0.588679
95% CONFIDENCE LIMIT = ± 1.17736

TEST: S04
MINIMUM VALUE = 0.11
MAXIMUM VALUE = 3.06
POPULATION = 23



ANOTHER FILE (Y/N) : _

APRIL - JUNE 1988

S04 STANDARD ADDITIONS

AVERAGE VALUE = 96.9409

STANDARD DEVIATION = 3.66572

95% CONFIDENCE LIMIT = ± 7.33144

TEST: S04

MINIMUM VALUE = 89.1

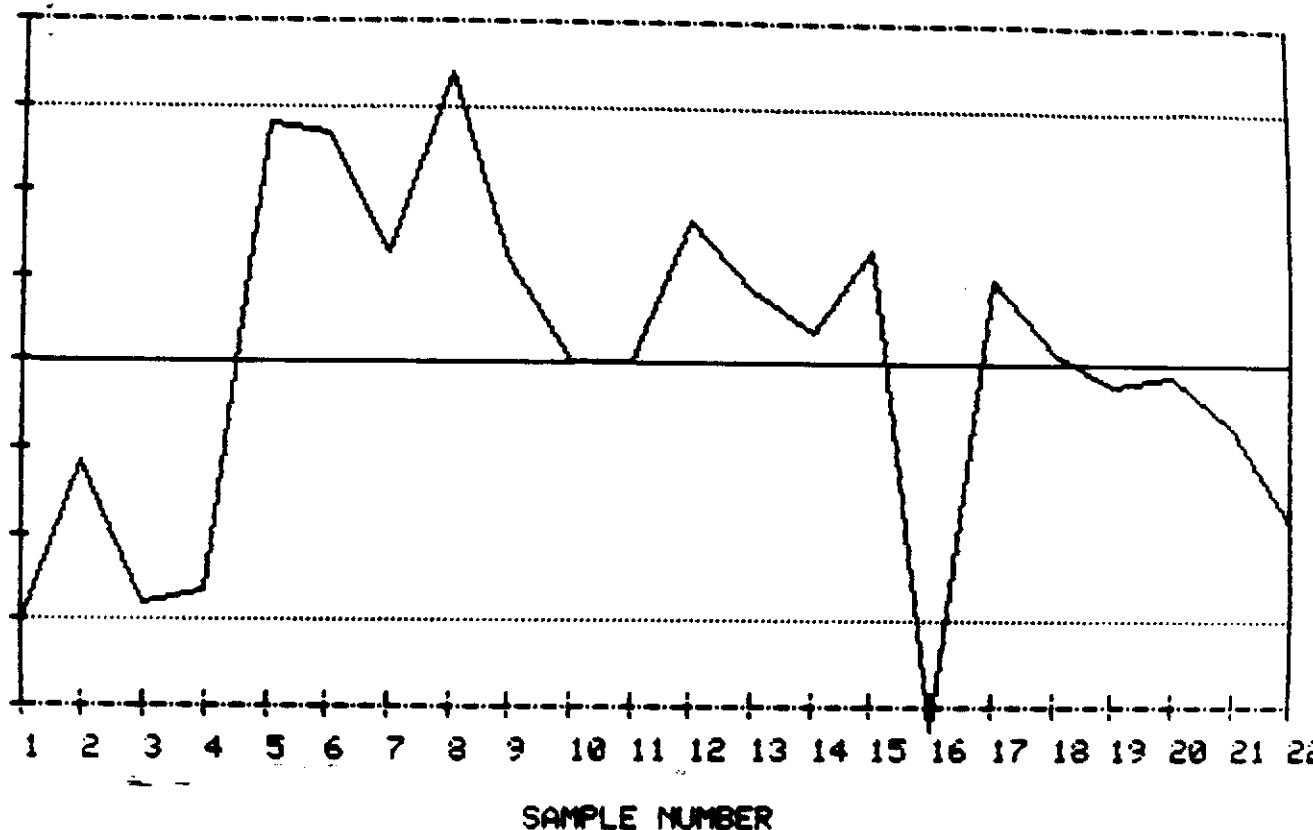
MAXIMUM VALUE = 103.2

POPULATION = 22

UPPERLIMIT
104.272

AVERAGE
96.9409

LOWERLIMIT
89.6095



ANOTHER FILE (Y/N) : _

JULY - SEPTEMBER 1988

.504 QC 1 = 25.0

AVERAGE VALUE = 24.808

STANDARD DEVIATION = 0.208854

95% CONFIDENCE LIMIT = ± 0.417707

TEST: 00S04

MINIMUM VALUE = 24.4

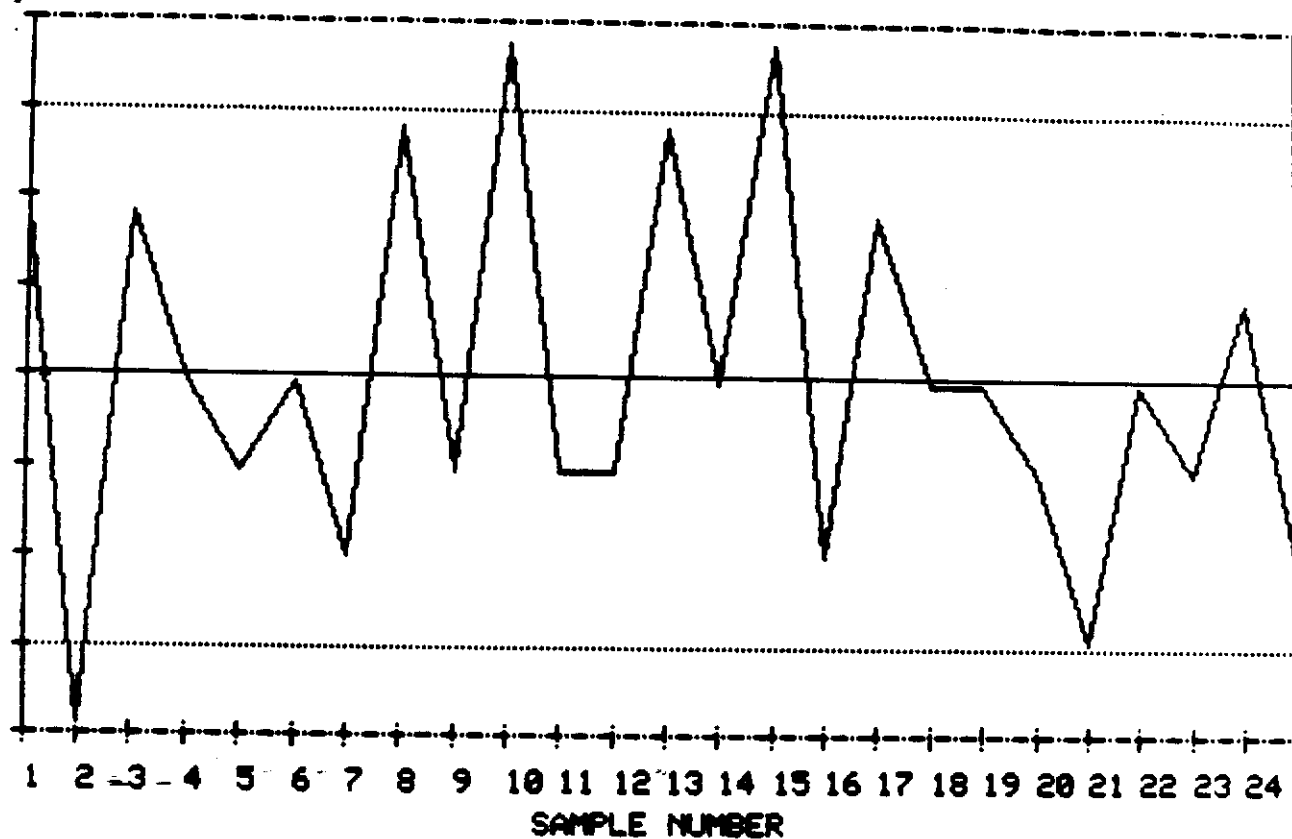
MAXIMUM VALUE = 25.2

POPULATION = 25

UPPERLIMIT
25.2257

AVERAGE
24.808

LOWERLIMIT
24.3903



ANOTHER FILE (Y/N) : _

JULY - SEPTEMBER 1988

S04 QC 2 = 186.

AVERAGE VALUE = 180.692

STANDARD DEVIATION = 2.02459

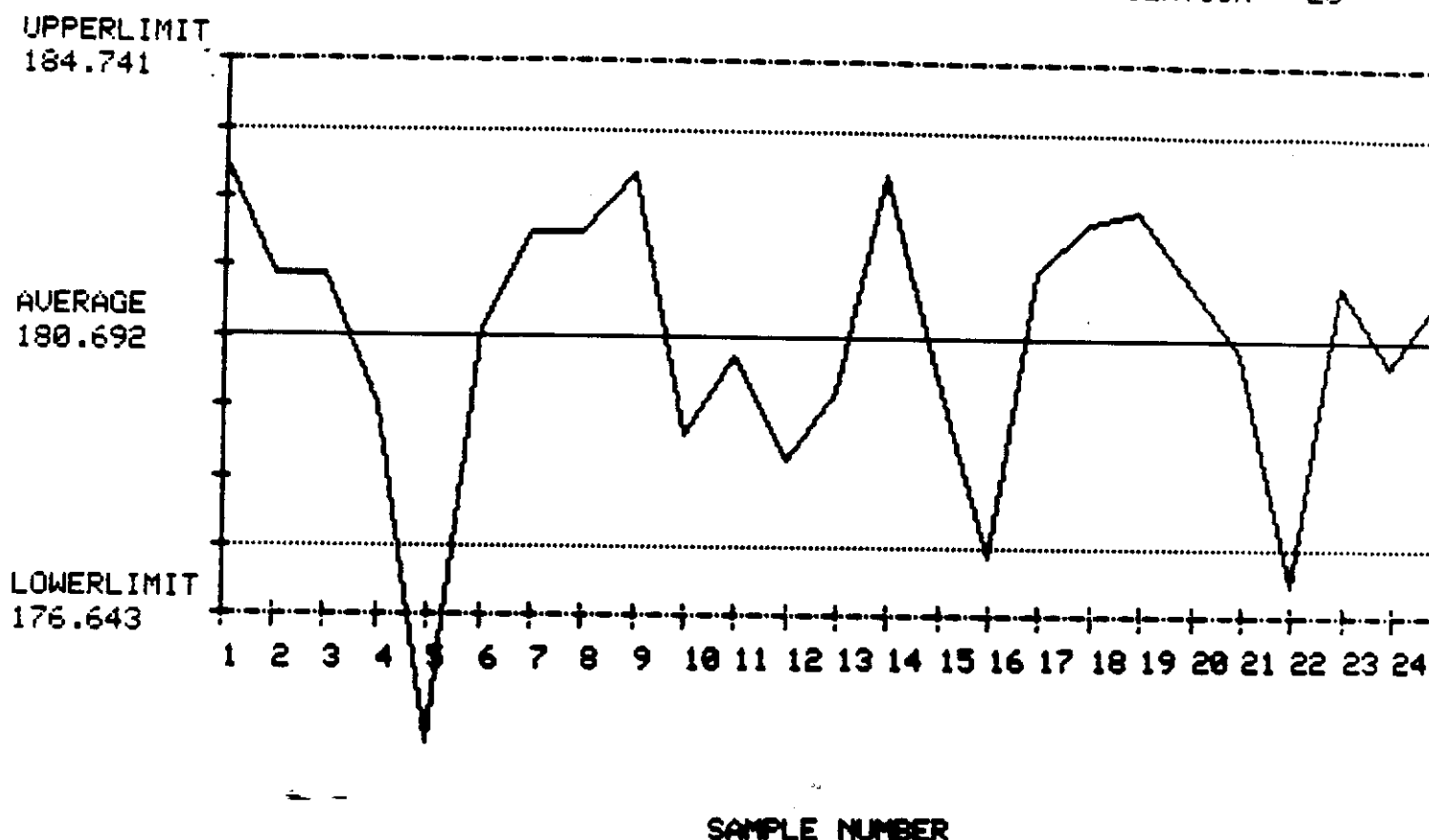
95% CONFIDENCE LIMIT = ± 4.04918

TEST: S04

MINIMUM VALUE = 174.

MAXIMUM VALUE = 183.

POPULATION = 25



ANOTHER FILE (Y/N) : _

JULY - SEPTEMBER 1988

.S04 COEFFICIENT OF VARIATION

AVERAGE VALUE = 0.5356

STANDARD DEVIATION = 0.443622

95% CONFIDENCE LIMIT = ± 0.987245

TEST: S04

MINIMUM VALUE = 0.

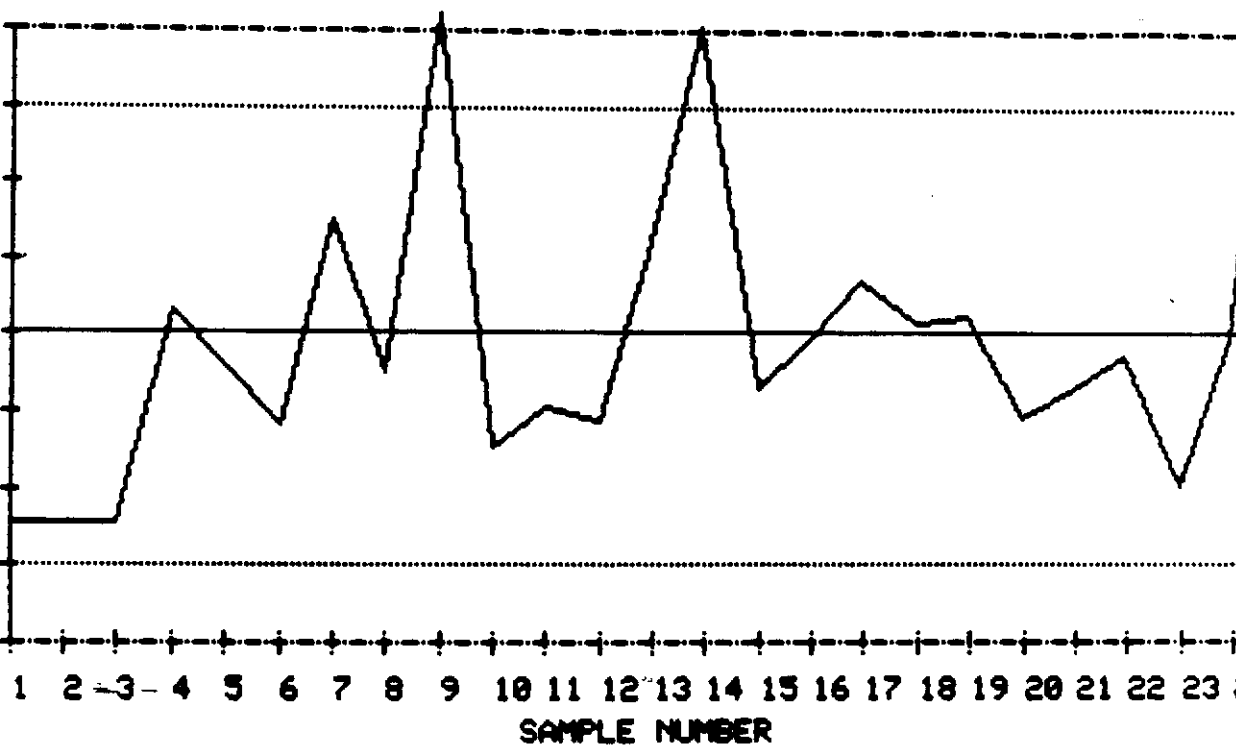
MAXIMUM VALUE = 1.

POPULATION = 25

UPPERLIMIT
1.42284

AVERAGE
0.5356

LOWERLIMIT
-0.351645



ANOTHER FILE (Y/N) : _

JULY - SEPTEMBER 1988

.S04 STANDARD ADDITIONS

AVERAGE VALUE = 94.4625

STANDARD DEVIATION = 3.40994

95% CONFIDENCE LIMIT = ± 6.81989

TEST: 00S04

MINIMUM VALUE = 88.0

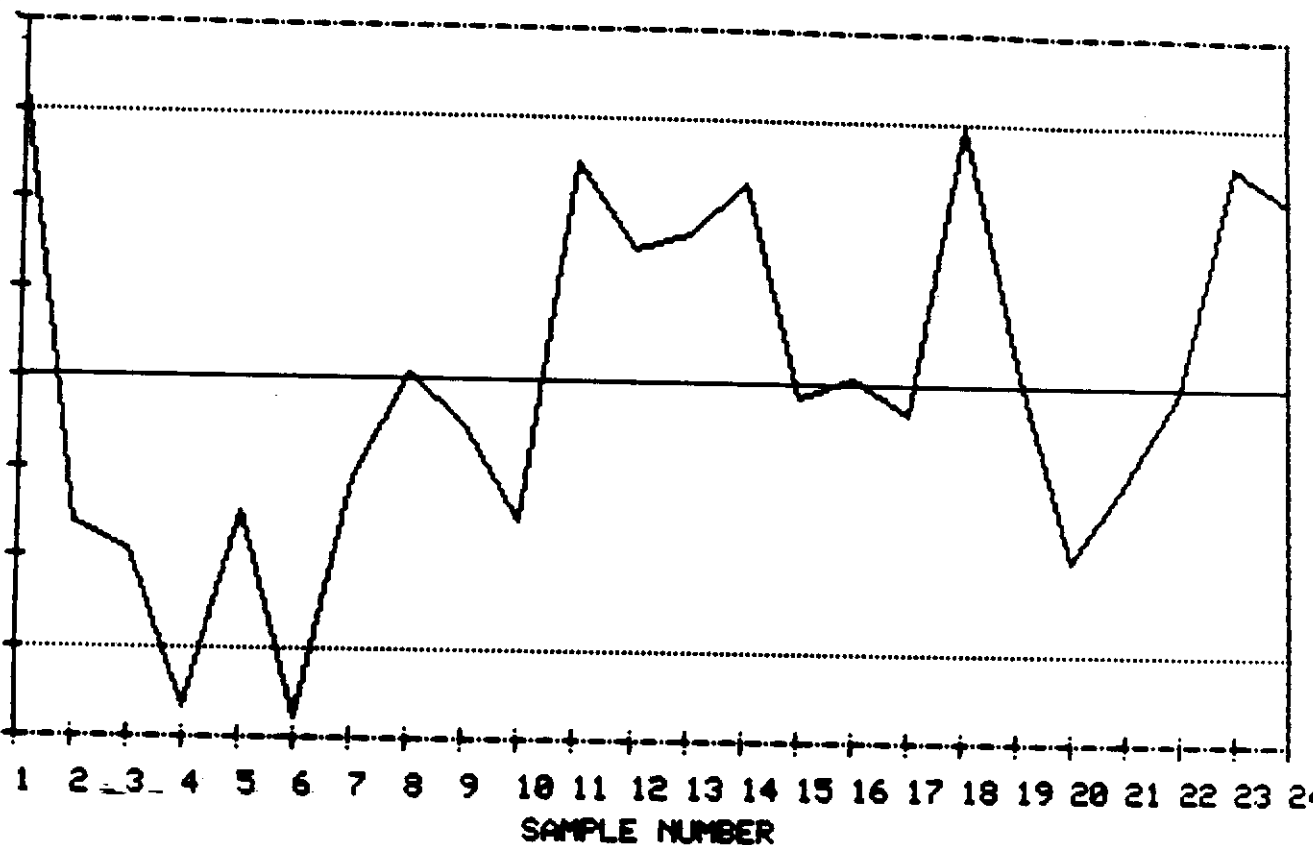
MAXIMUM VALUE = 100.0

POPULATION = 24

UPPERLIMIT
101.282

AVERAGE
94.4625

LOWERLIMIT
87.6426



ANOTHER FILE (Y/N) : _

OCTOBER - DECEMBER 1988

004 QC 1 = 25.

AVERAGE VALUE = 25.0348

STANDARD DEVIATION = 0.312216

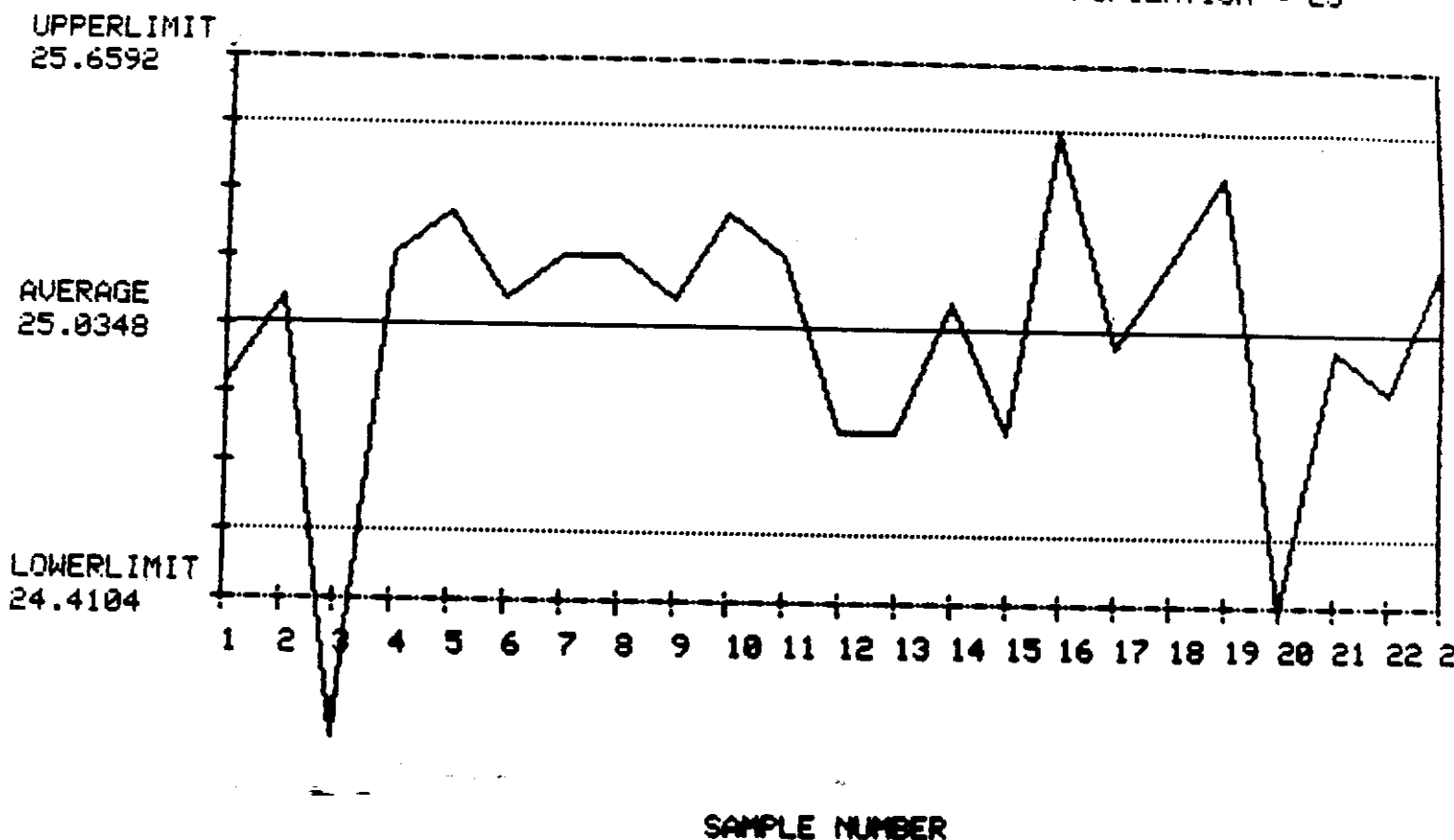
95% CONFIDENCE LIMIT = ± 0.624431

TEST: 00S04

MINIMUM VALUE = 24.1

MAXIMUM VALUE = 25.5

POPULATION = 23



SAMPLE NUMBER

ANOTHER FILE (Y/N) : _

OCTOBER - DECEMBER 1988

604 QC 2 = 186

AVERAGE VALUE = 181.457

STANDARD DEVIATION = 1.2792

95% CONFIDENCE LIMIT = ± 2.55841

TEST: 0504

MINIMUM VALUE = 179.2

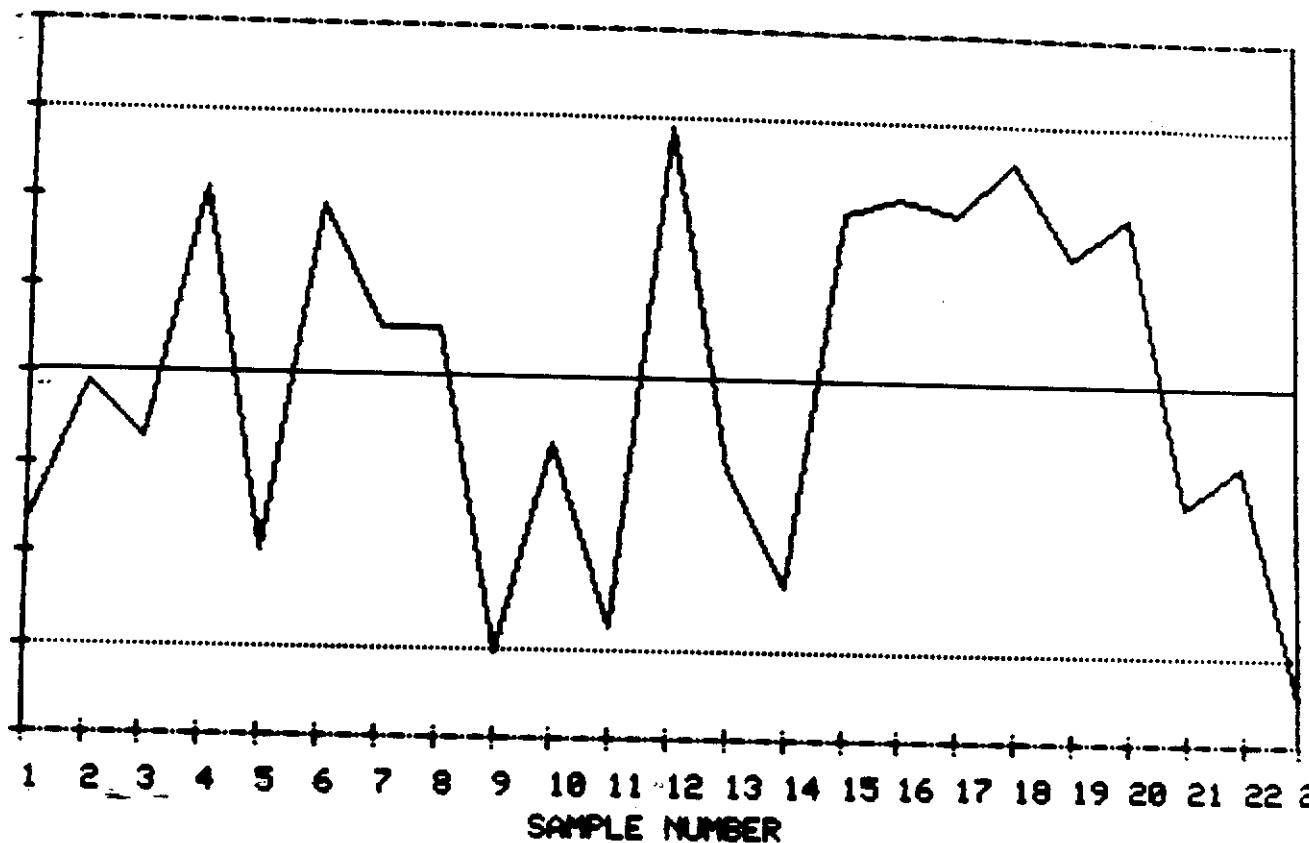
MAXIMUM VALUE = 183.3

POPULATION = 23

UPPERLIMIT
184.015

AVERAGE
181.457

LOWERLIMIT
178.898



ANOTHER FILE (Y/N) : _

OCTOBER - DECEMBER 1988

SO4 COEFFICIENT OF VARIATION

AVERAGE VALUE = 0.513913

STANDARD DEVIATION = 0.407584

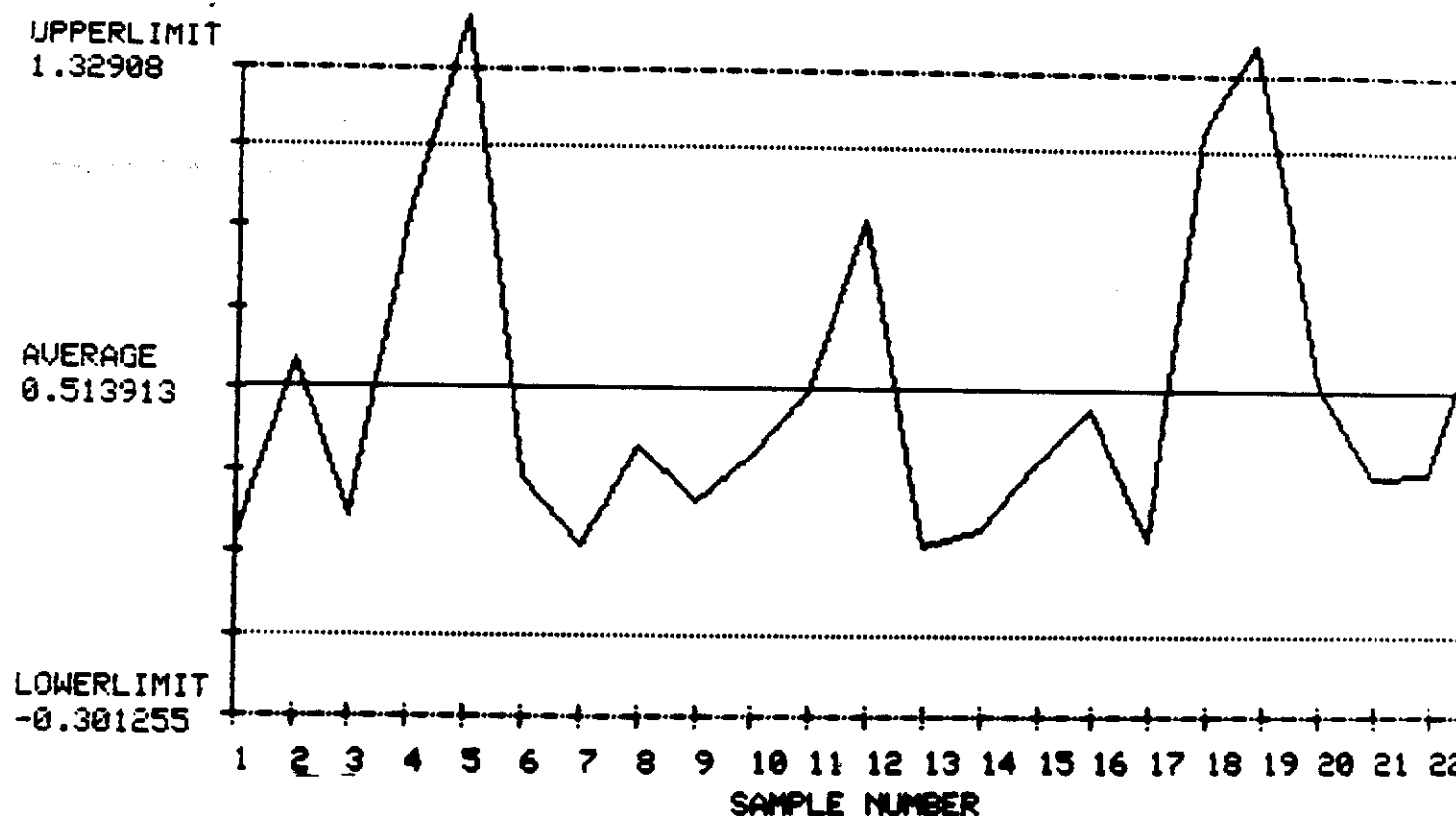
95% CONFIDENCE LIMIT = ± 0.815168

TEST: 0S04

MINIMUM VALUE = 0.12

MAXIMUM VALUE = 1.4

POPULATION = 23



ANOTHER FILE (Y/N) : _

OCTOBER - DECEMBER 1988

SQ4 STANDARD ADDITIONS

AVERAGE VALUE = 97.6176

STANDARD DEVIATION = 2.44246

95% CONFIDENCE LIMIT = ± 4.88493

TEST: SQ4

MINIMUM VALUE = 91.7

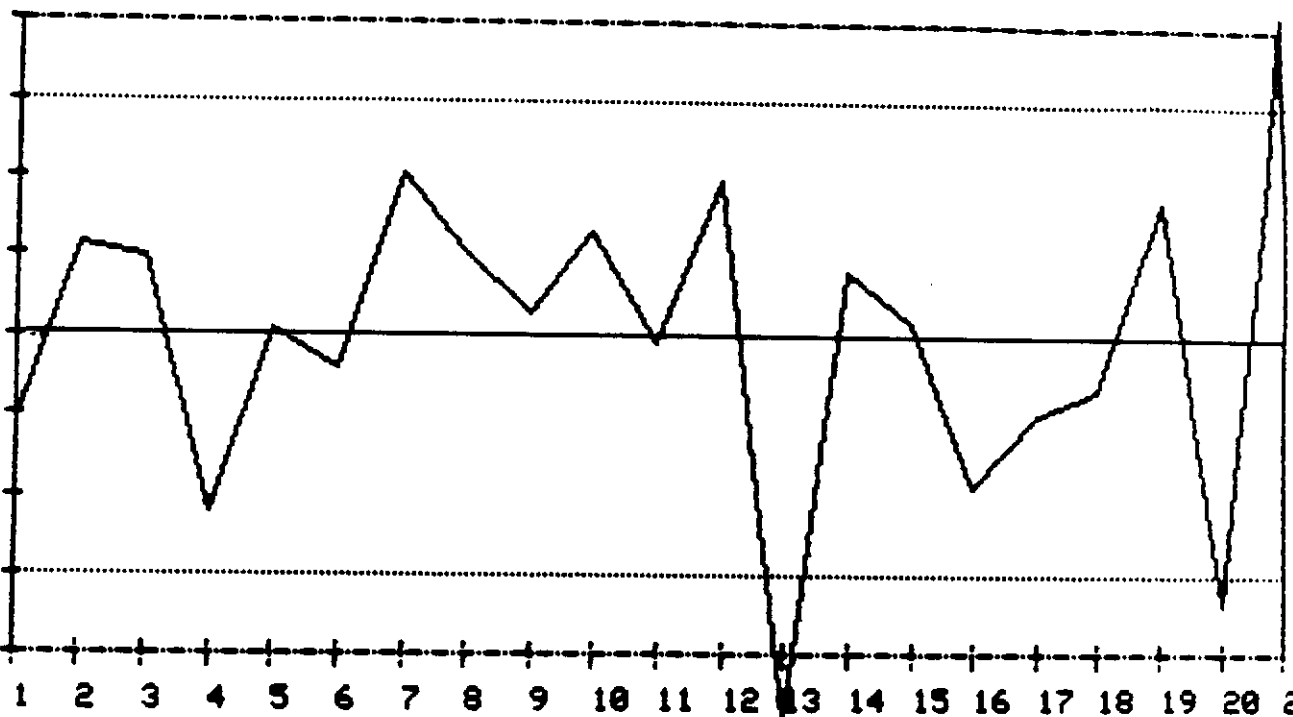
MAXIMUM VALUE = 102.7

POPULATION = 21

UPPERLIMIT
102.503

AVERAGE
97.6176

LOWERLIMIT
92.7327



SAMPLE NUMBER

ANOTHER FILE (Y/N) : _